METHOD AND APPARATUS OF MANAGING EPHEMERAL, FUNGIBLE COMMODITIES BASED UPON REAL-TIME FORWARD PRICES

Technical field

This invention relates to planning and managing the operation of devices using ephemeral, fungible commodities with regards to trading and traded electrical power as applied to grids of one or more AC power networks.

Background Art

As used herein, a fungible commodity will refer to a commodity traded strictly in terms of the quantity of that commodity. No single unit of a fungible commodity is distinguishable from another unit of that commodity. A kilowatt-hour of 60 Hz AC power delivered on a power line is not distinguishable from another kilowatt-hour delivered at the same time to the same place on the same line. An ephemeral, fungible commodity is a fungible commodity whose existence is extremely short-lived. Electrical power generation, network bandwidth, seats on an airplane and entry slots onto a freeway during rush hour are all examples of fungible commodities which exist but for a short duration of time. In contradistinction, starting lots in an assembly line produce tangible results, which may differ widely in content, thus showing an example of an ephemeral, non-fungible commodity.

Many devices use one or more ephemeral, fungible commodities during their operation. Some devices can make one or more ephemeral, fungible commodities during their operation. Examples include but are not limited to hydro-electric dams, video content providing servers, airports preparing airplanes

for departure (thus providing airplane seats on those airplanes) and freeway on ramps. Some devices consume one or more ephemeral, fungible commodities during their operation. Examples include but are not limited to home appliances, most factories, video content subscribers, air flight travelers and motorists trying to enter freeways via free way on-ramps. Some devices transport one or more ephemeral, fungible commodities during their operation. Examples include but are not limited to electrical transmission lines, communication networks, airline transfer points connecting various air flights and freeway interchanges. Some devices make one kind of ephemeral, fungible commodity while consuming another kind of ephemeral, fungible commodity. Examples include but are not limited to DC to AC power converters and network bridges, routers, gateways and firewall servers.

In each and every example just mentioned there is a need to provide a method of planning which accounts for the economics of consumption, generation and transport of these ephemeral, fungible commodities. There is a further need to be able to account for the time variations in the economics of consumption, generation and transport of these ephemeral, fungible commodities. There is a further need to control such devices based upon the results of such planning. There is an additional need to meter the usage and cost of these devices based upon the time varying economics of these ephemeral, fungible commodities. There is a further need to meter usage and cost of such devices under operation based upon the time variations in the economics.

Ever since the invention of AC power technology, this and many other countries have benefited from the ability to share the use of AC electrical power across great distances. This AC power technology has proven to be of enormous value. However, the management and control of AC power networks have shown themselves to have fundamental problems. Before discussing these management and control problems, it is important to consider some of the basic physical properties of electrical power distribution.

An AC power network is an electrical network connecting AC power generators to AC power loads on power lines controlled so that the network as a whole can be seen to function at an essentially constant frequency and uniform phase across the network. Drifts in phase are compensated by phase shifting devices to enforce the uniform phase property across the AC power network. Drifts in frequency are compensated at the generators. Such frequency variations are typically caused by variances between the loads and generated power. The effect of these compensations is to operationally provide essentially constant frequency and uniform phase throughout the AC power network. The AC power distribution frequency in the United States, Canada, Mexico and some other countries is 60 Hz and in some other countries is 50 Hz. In certain cases, the power is distributed in a 2-phase transmission scheme. In certain other instances, the power is distributed in a 3-phase transmission scheme.

A grid as used herein will refer to an electrical power system which may comprise more than one AC power network as well as DC power lines which may transfer energy between nodes of different AC power networks or between nodes of a single AC power network.

Cities, generators and the like act as the nodes of an AC power network. A specific node may actually comprise more than one generator or load. A bus locally connects these local facilities of a node. High voltage AC transmission lines transfer power between the cities and the generators in major load centers of an AC power network. By way of example, in the United States, there's an AC power network that covers what is called the Western States Coordinating Council, which goes from British Columbia in Canada down to Northern Mexico and over to the Rocky Mountains. There's another AC power network in Texas and there's another AC power network essentially covering the rest of the United States and Canada, with the exception of a portion of Quebec. These three AC power networks are connected together by direct current lines to form the North American grid. They're not connected in AC. They are asynchronous, in that they

are not synchronized either in terms of frequency or phase across the United States, Canada and northern Mexico.

Electrical power generation can be readily seen to be ephemeral and fungible. One kilowatt is reasonably treated the same as another, persisting only a relatively short period of time. Electrical power transmission can also be seen as ephemeral and fungible. Electrical power transmission is most commonly performed as AC transmission lines between nodes of an AC power network. DC power lines are used additionally to connect specific nodes of either a single AC power network or nodes of distinct AC power networks.

Electrical power storage is of typically limited time duration. The most commonly used storage system is to pump water up hill to a storage site where it is held until needed. When needed, it is gravity-fed through one or more turbines to generate electricity. Such systems, for economic reasons, are not used to store power for very long, often for no more than a day or two. It should be noted that the interface points for power into such systems are ephemeral and fungible.

Power switching between lines involving high power (megawatts and above) is not commonly done. Current examples of AC power switching include switching between amplifiers and antenna feeds in broadcast radio systems, and typically involve no more than a fraction of a megawatt. However, if such systems components someday become capable of handling large power lines, power traversing the interfaces of such switches to a power network would still be ephemeral and fungible.

There are some basic physical properties distinguishing AC power distribution systems from other flow-based systems such as DC power, gas, water and oil transmission systems. AC power networks differ from gas, water, oil and other fluid flow distribution systems in that changes in power generation and loading propagate across such networks at approximately the speed of light. The effect

of power generation and power loading effects the whole AC power network in a manner that, for practical purposes, is simultaneous.

Due to the stability of frequency and phase across an AC power network, changes in power have a super positioning effect. This insures that the power being carried on any line in the network is essentially a linear function of the generators and loads on the network. Furthermore, if a path of lines connects two nodes, generating power at the first node carried by the path is offset by power generated at the second node, as related by the above mentioned linear function.

These AC power networks are operated within a safe range, so that the patterns of flows are fairly predictable, given the configuration of the network does not change. The National Electric Reliability Council computes a system of a set of numbers called transfer distribution factors available on the North American Reliability Council website, www.nerc.com, showing how the power is distributed across these various lines. It is a linear function of the amount injected, which changes sign when the direction of transfer changes from Node1 to Node2 into Node2 to Node1. Such functions are skew symmetric with respect to the nodes.

Consider a DC network: one can directly control the delivery of power from one point to another. This cannot be done on AC power networks. It is a characteristic of AC power networks that all lines are affected in roughly fixed proportions, by the previously mentioned transfer distribution factors and by the generating and loading at specific nodes.

By way of example, when AC power is sent from Bonneville Power Authority in the state of Washington to San Francisco, some of it comes down the direct path and some of it comes down through Idaho to Arizona and back up from Southern California to Northern California. One may be limited in what can be brought from the Bonneville Power Authority to San Francisco because there's a problem with the flow coming up from Southern California to Northern California.

Consider an AC power network. It turns out that it is unlimited in how often power can be injected somewhere in that network and taken out by a load elsewhere in that network. Eventually though, the network runs out of capacity. There are certain lines or collections of lines of the network that are going to run out ahead of others and those constrained flow elements are a big problem for the electricity industry. These lines may typically be limited either by line carrying capacity or by transformer capacity limits associated with those lines. Note that there may be more than one transformer involved and that different transformers may have differing transformer capacity limits. These constrained flow elements are called flow gates. In the last few years the importance of flow gates has begun to emerge through the actions of NERC, which has been responsible for building a model estimating flow gate impact, which can be downloaded from their web site.

A flow gate of a given AC power network will refer herein to a collection of at least one line whose total maximum safe carrying capacity will act as a congested element of the network, constraining AC power delivery between two or more nodes of that network.

All lines have maximum safe carrying capacities and thus could be considered flow gates, of a sort. However, historical congestion analysis of specific AC power networks reveals that only a small number of flow gates account for almost all congestion problems. Such flow gates will be herein referred to as significant flow gates.

The associated AC power transfer across a given flow gate is additive due to the super positioning effects previously discussed. Thus in sending 100 megawatts along a path, the transmission may have a 10% impact on the flow gate, putting 10 megawatts on the flow gate. A second generator may have a 5% impact on that flow gate. Generating 100 megawatt at the second generator would add 5 across the flow gate.

Figure **1** depicts an exemplary AC power network based upon contemporary AC power technology as found in the prior art. The network contains 12 nodes labeled **10**, **20**, **30**, **40**, **50**, **60**, **70**, **80**, **90**, **100**, **110** and **120** respectively.

AC transmission line **12** runs between node **10** and node **20**. Line **14** runs between node **10** and node **40**. Line **22** runs between node **20** and node **30**. Line **32** runs between node **30** and node **40**. Line **42** runs between node **40** and node **120**. Line **44** runs between node **40** and node **60**. Line **46** runs between node **40** and node **50**. Line **52** runs between node **50** and node **110**. Line **54** runs between node **50** and node **60**. Line **56** runs between node **50** and node **70**. Line **62** runs between node **60** and node **110**. Line **64** runs between node **60** and node **70**. Line **82** runs between node **80** and node **120**. Line **92** runs between node **90** and node **120**. Line **94** runs between node **90** and node **110**. Line **96** runs between node **90** and node **100**. Line **102** runs between node **100** and node **110**. Line **112** runs between node **110** and node **120**.

Flow gate A **210** is a constraint on the network. Lines **32**, **34** and **42** are constrained by flow gate A **210** by a total maximum safe carrying capacity, in that these lines have transmission capacity limitations which are easily overloaded when this maximum safe carrying capacity is exceeded.

Flow gate B **220** is a constraint on the network. Lines **42** and **44** are constrained by flow gate B **220**. These lines are also constrained by a total maximum safe carrying capacity due to system limitations, such as their proximity at some critical junction of the system, such as a mountain pass.

Flow gate C **230** is a constraint on the network. Lines **52** and **62** are constrained by flow gate C **230** to a total maximum safe carrying capacity.

Figure **2** depicts a list of associated AC power functions for each flow gate of a collection of flow gates for each of the busses of the various nodes of the exemplary AC power network of Figure **1** as disclosed in the prior art.

Bus **1** locally connects all facilities of Node **10**. Bus **2** locally connects all facilities of Node **20**. Bus **3** locally connects all facilities of Node **30**. Bus **4** locally connects all facilities of Node **40**. Bus **5** locally connects all facilities of Node **50**. Bus **6** locally connects all facilities of Node **60**.

Bus **7** locally connects all facilities of Node **70**. Bus **8** locally connects all facilities of Node **80**. Bus **9** locally connects all facilities of Node **90**. Bus **10** locally connects all facilities of Node **100**. Bus **11** locally connects all facilities of Node **110**. Bus **12** locally connects all facilities of Node **120**.

Note that the facilities at these nodes, connected by the associated buss, often vary greatly in terms of generation capacity as well as loading capacity. By way of example, a city often consumes far more AC power than it generates. Another example, a node for a major hydroelectric dam such as Grand Coulee Dam would tend to generate far more AC power than it consumed.

Note that the associated AC power functions for the various busses are all fractions of 1, since the most power that could be transferred is the amount of power at the generation node. Note further that some of these AC power functions are negative. Buss **10** has strictly zeroes for its power function. It is essentially acting as a reference node for calculating the associated functions.

Now consider the historical market of electrical power and electrical power transmission. For a variety of historical and technological reasons, electric power has long been a notable exception to a commodity market approach. The ability of buyers and sellers to negotiate and implement deals remains severely restricted, even where the electric power industry has been deregulated. The usual argument for these restrictions revolves around reliability.

In the United States, the Federal Energy Regulatory Commission (FERC) called for the development of Regional Transmission Organizations (RTOs) to better

coordinate markets and foster reliability (Docket No. RM99-2-00 issued May 13, 1999).

The electric power industry has a long history of using centralized dispatch to manage generation, as opposed to open markets. Centralized dispatch was suited to an industry consisting of vertically integrated monopolies. The traditional approach to RTO design so far has been to retain as much of this centralized control as possible, while opening access to competitive wholesale and retail participants. The result has been volatile prices, settlement disputes, and difficulties matching supply and demand on an instantaneous basis. The basic problem is that centralized dispatch does not work well where participants do not have common ownership or objectives.

RTO's have certain essential technical functions: providing an overall focus on reliability, regional security coordination and emergency operator intervention. RTO's have problems in the areas of scheduling, congestion management, ancillary service provisions, metering, billing and settlements. As used herein, an ancillary service often involves power generation. A power generation facility will reserve some production capacity to be available at the operators request in real-time to support balancing the network and to deal with emergency requirements which can rapidly be addressed by the reserved production capacity. Note that all the problem areas involve ephemeral, fungible electrical commodities or the economic results of transactions involving ephemeral, fungible electrical commodities.

Consider how AC power transfers are managed today. Transmission rights are considered and negotiated in terms of point-to-point transfers within the network known as contract paths. Such thinking is contrary to the previously discussed physics of these AC power networks, because changes in power generation or load at any node have an essentially linear effect on all transmission lines in the

network, and consequently impact all flow gates within that network to some extent.

This contract path system of scheduling power transmission reserves transmission rights along a particular, direct path through the AC power network. This is done by purchasing transmission rights from each of the transmission line owners for each of the lines making up the direct path. It often occurs that some constraint, occurring across a significant flow gate off that direct path, actually limits the transmission capability on the direct path.

The contract path system maintains the fiction that AC power can be directed to follow a path through the network chosen as one might with natural gas. By changing the valves, one can mythically direct AC power a particular way through the AC power network. The contract path system was put in place because it was thought conceptually easier since one only had to make reservations along the single path. The fundamental problem with the contract path approach is that the contract path arrangement for transmission does not accord with the way the power actually flows in an AC power network.

Today's contract path is based upon a first-come, first-served priority scheme. What is bought has very limited resale capability. By way of example, consider three nodes A, B and C of an AC power network. Suppose one bought a power transmission from A to B and bought a transmission from B to C. Using contract path approach, that does not mean one owns the power transmission from A to C, because contract paths are not additive. Owning power transmission from A to B and from B to C would not entitle power transmission from A to C. To transport from A to C, one would have to purchase separately transmission from A to C. This is because there might be some flow gate constraint which would not be met in the two separate paths which would be triggered in the combined path. So in the contract based market, which is the traditional market, once the

transmission from A to B is purchased, it's only value is for moving energy from A to B.

Today, there are several ad hoc approaches to limiting flow on one path because of the impact on another path. These approaches ignore the physics of AC power networks. This leads to situations where even though some other path may actually be the constraint, when a particular path becomes over-constrained, cuts are issued across apparently irrelevant contracted paths to compensate. The central operator acts, because a flow gate will overflow, forbidding transmission often across apparently irrelevant paths to compensate.

Another alternative approach is to take all of these generator costs, and the preferences of the buyers, into a mathematical optimization program, and figure out the optimal flow. This alternative approach has significant disadvantages. In a commercial market, getting people to reveal all their costs is quite difficult. Most people are very reluctant to do that. Further, such costs frequently change. The loads will have to reveal their preferences between consuming and non-consuming players, which is a tremendous informational burden. It is extremely unlikely that they could or would do it. Even if they did, all this information is a tremendous burden on the central operator collecting all the information.

Such an alternative approach requires two-way communication among all the players, with all these devices and systems to control, when the people consume power and when they turn on and off these distributed devices. It has proven impossible to provide the requisite level of reliable communication and direct control systems. Besides, people are unwilling to turn over control of their business lives to a central operator.

Another approach in industry is a power pool called PJM, for Pennsylvania, New Jersey and Maryland, who have developed a system called locational marginal pricing. It is a central dispatched methodology. However, a local flow model is buried within it. It supports some centralized management of generators, related

equipment and facilties in order to get a consistent solution that is based upon the power distribution matrix.

This approach suffers from at least the same problems facing any other centralized control scheme. There is a very limited amount of detailed information such a system can acquire, or use, to optimize AC power transfers. The power users are again blind to their options. The players cannot determine what works best for them. The central operator dictates to them. It is difficult to imagine that such a situation could be optimal.

Additionally, another major disadvantage of this approach is that prices are not known until after the transaction is completed. Participants must resort to separate financial instruments if they wish to hedge these prices, so as to "lock-in" their gain or loss prior to the transaction. The trading of these financial instruments provides no feedback to the actual LMP solution, losing critical forward market information that could contribute to market efficiency and price stability.

NERC has developed a methodology addressing flow gates to some extent. This is discussed in a document entitled "Discussion Paper on Aligning Transmission Reservations and Energy Schedules to Actual Flows", distributed in November, 1998 by the NERC Transaction Reservation and Scheduling Self-Directed Work Team. This team proposed an electrical power industry shift to a system of reserving and scheduling transmission based on actual use of congested flow gates, which they called the FLOWBAT method. Their proposal suffers from a serious omission, it does not address the issue of allocating flow gate capacity when demand exceeds supply. By their silence on this issue, it appears that they would continue the current practice of first-come, first-served allocation. The flaws discussed above for centralized planning continue to be relevant in this approach.

NERC has also supported the General Agreement on Parallel Paths experiment (GAPP). GAPP is a system whereby one transmission provider compensates a second transmission provider for the parallel power flows occurring on a second transmission provider's system caused by transactions authorized by the first transmission provider. GAPP relies on distribution functions, in this case called Transaction Participation Functions (TPFs). These distribution functions refer to transmission paths rather than flow gates. GAPP attempts to align compensation paid by transmission users with actual power flows. However, GAPP is strictly an after-the-fact settlement system. It alters the current contract path scheme only to redistribute the revenue. It does not attempt to allocate scarce transmission capacity.

To summarize, in at least each and every example just mentioned there is a need to provide a method of planning which accounts for the economics of consumption, generation and transport of these ephemeral, fungible commodities. There is a further need to be able to account for the time variations in the economics of consumption, generation and transport of these ephemeral, fungible commodities. There is a further need to control such devices based upon the results of such planning. There is a further need to meter usage and cost of such devices under operation based upon the time variations in the economics. What is further needed is a trading mechanism for electrical ephemeral, fungible commodities optimizing the scheduling, congestion management, ancillary services, metering, billing and settlements of accounts for electrical grids. Further, what is needed is an AC power transmission market system complying with the physics of AC power networks. Further, since transmission rights are predominantly constrained by significant flow gates, what is needed should account for the effect on the significant flow gates for each contracted transmission. A method and mechanism is needed for planning the operations of devices and further controlling the devices based upon trading

generation and transmission rights in a timely, reliable and efficient manner which automatically guarantees correct operation of the power grid.

Summary of the Invention

Certain embodiments fulfill at least the requirements and needs discussed with regards to the prior art.

Certain embodiments include a method of planning a device consuming an ephemeral, fungible commodity based upon a knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a cost. The method comprises determining the ephemeral, fungible commodity needs over a planning time interval and examining the knowledge interval collection based upon the ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule.

Such a method advantageously incorporates forward market pricing of the ephemeral, fungible commodity as represented by the knowledge intervals to create a device operating schedule.

Certain further embodiments include creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection. Such embodiments advantageously support the creating of new knowledge of forward market pricing into the knowledge interval collection.

Certain further embodiments support creating the first knowledge interval by receiving and creating the first knowledge interval based upon a knowledge interval creation message to create the first knowledge interval. Such embodiments advantageously support message passing to distribute forward market pricing information.

Certain further embodiments support the processing of the received knowledge creation message to create the first knowledge interval and inserting the first knowledge interval into the knowledge interval collection. Such embodiments advantageously support at least one, if not all of the collection comprising encryption, error detection and correction coding and authentication analysis during the processing of the received knowledge interval creation message.

Certain embodiments support replacing, modifying and removing a previous second knowledge interval in the knowledge interval collection based upon the time intervals of the first and second knowledge intervals. Such embodiments advantageously support modification of the time intervals being stored in knowledge intervals of the knowledge interval collection.

Certain embodiments support knowledge intervals comprising a time interval collection containing at least one time interval. Certain further embodiments support knowledge intervals with a time interval collection of one time interval. Certain other further embodiments support time interval collections with at least two time intervals. Such embodiments advantageously support off-peak knowledge intervals as well as provide a notation for updating a knowledge interval collection containing a second knowledge interval with a first knowledge interval comprising an overlapping time interval.

Certain embodiments support removing knowledge intervals from the knowledge interval collection. Such embodiments advantageously support maintaining the knowledge interval collection within predetermined size constraints. Certain further embodiments support knowledge interval removal based upon a received, processed knowledge interval removal message, advantageously supporting issuance of knowledge interval removal from an external source. Certain other further embodiments support establishing a real time and the removal of knowledge intervals which precede the real time, advantageously supporting the localized removal of knowledge intervals. In certain embodiments, a time interval

precedes the real time if it is more than a pre-determined time-increment earlier. Such predetermined time-increment may be an hour, day, week, month, or some number of billing periods in temporal size.

Certain embodiments support creation and removal of knowledge intervals by receiving and processing knowledge interval messages indicating whether to create or remove knowledge intervals based upon the contents of the knowledge message. Such embodiments advantageously support a unified message processing protocol incorporating various knowledge interval collection operations including at least the creation and removal of knowledge intervals. Such embodiments may further advantageously support encryption, error detection and correction, as well as authentication.

Certain embodiments include maintaining a bid interval collection of bid intervals of the ephemeral, fungible commodity, each comprising a bid price, a bid amount and a bid time interval. Such embodiments advantageously support tracking the bidding on the ephemeral, fungible commodity in a collection of time intervals.

Certain further embodiments include making a first bid of the bid interval collection and committing of the first bid interval to create a committed first bid interval of the bid interval collection and using the committed first bid interval to create the first knowledge interval of the knowledge interval collection. Such embodiments advantageously support virtual trading in the ephemeral, fungible commodity and the incorporation of agreed contracts into the knowledge interval collection used to create the device operating schedule.

Certain further embodiments support incorporation of an amount into the knowledge intervals of the knowledge interval collection and creation of the amount in knowledge intervals based upon the amount in the committed first bid interval. Such embodiments further advantageously support virtual trading in the ephemeral, fungible commodity and the incorporation of agreed contracts into the knowledge interval collection used to create the device operating schedule. Note

that the setting of the amount and cost in the first knowledge interval can incorporate regulatory tariffs, taxes, and other overhead not necessarily directly present in the bid interval itself.

Certain other further embodiments include determining the ephemeral, fungible commodity needs over the planning time interval comprising examining an equipment usage collection comprised of equipment usage entries each containing a delivery time and a need schedule for the ephemeral, fungible commodity to create the ephemeral, fungible commodity needs over the planning time interval comprising an amount. Such embodiments advantageously support situations in which a variety of equipment usage with delivery times and need schedules may be integrated to create the commodity need for the time interval. By way of example, the dishes may need washing before dinner, but the laundry must be done before breakfast.

Certain further embodiments include the ephemeral, fungible commodity needs over the time interval further comprising a cost limit. Making the first bid of the first bid amount at the first bid price for the first time interval is based upon the ephemeral, fungible commodity needs over the time interval comprising the amount and the cost limit. Such embodiments further advantageously support trading in ephemeral, fungible commodities based upon the cost constraints of the consumer of those commodities. By way of example, a factory may commit to making a certain number of units at a given sales price by a specified delivery time. This commitment constrains what that factory can spend on the ephemeral, fungible commodity to make those units, as well as determine the amount, delivery time and need schedule of that commodity.

Certain other further embodiments include creating the device operating schedule including determining an equipment usage plan containing an equipment usage item. Each equipment usage item is comprised of an action belonging to an action collection comprising start-action, stop-action and throttle-

action; as well as an activation time. Such embodiments advantageously support the generally required activities of starting, stopping and changing the operational parameter(s) or throttling of the device.

Certain further embodiments include a method of controlling the device consuming the ephemeral, fungible commodity based upon the knowledge interval collection. Such a method includes the method of planning the device to create the device operating schedule as disclosed herein and operating the device based upon the device operating schedule. Such embodiments advantageously support not only planning for the device, but also operating the device based upon the device operating schedule.

Certain further embodiments include at least one of the operations in the collection of starting, stopping and throttling the device. These embodiments advantageous reflect the most basic operations of typical devices consuming the ephemeral, fungible commodity. Certain further embodiments include each of the operations of starting, stopping and throttling the device. These embodiments further advantageously reflect the most basic operation of most typical devices consuming the ephemeral, fungible commodity.

Certain further embodiments include starting, stopping and throttling the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of a start-action, stop-action and throttle-action, respectively. Such an embodiment advantageously starts, stops and throttles the device based upon the respective action in an equipment usage item of the equipment usage plan.

Certain further embodiments include the equipment usage item comprised of the throttle-action and further comprised of a throttle-setting. Throttling the device based upon the device operating schedule is further based upon at least one of the equipment usage items of the equipment usage plan comprised of the throttle-action and the throttle-setting. Such embodiments advantageously

provide for variation in operational parameters through the throttle-setting in a throttle-action equipment usage item.

Certain further embodiments include the equipment usage item comprised of the start-action and further comprised of a throttle-setting. Starting the device based upon the device operating schedule is further based upon at least one of the equipment usage items of the equipment usage plan comprised of the start-action and the throttle-setting. Such embodiments advantageously provide for start-up parameterizations through the throttle-setting in a start-action equipment usage item.

Certain embodiments further include the device comprising a device collection containing at least two devices consuming the ephemeral, fungible commodity. Operations include the method of planning the device consuming the ephemeral, fungible commodity based upon the knowledge interval collection to create the device collection operating schedule and operating the device collection based upon the device collection operating schedule. Such embodiments advantageously support planning and operating multiple devices. Examples of such embodiments include but are not limited to households in industrialized countries with multiple devices consuming electricity and assembly plants with a variety of electricity consuming devices.

Certain further embodiments include operating the device collection based upon the device collection operating schedule comprising at least one of the collection including starting at least one device of the device collection, stopping at least one device and throttling at least one device. These embodiments advantageously reflect the most basic operations of typical devices consuming the ephemeral, fungible commodity.

Certain further embodiments include operating the device collection based upon the device collection operating schedule comprising at least one of the collection for each device of the device collection including starting the device, stopping the

device and throttling the device. These embodiments further advantageously reflect the most basic operations of typical devices consuming the ephemeral, fungible commodity.

Certain further embodiments include operating the device collection based upon the device collection operating schedule comprises for each device of the device collection comprising starting the device, stopping the device, throttling the device. These embodiments further advantageously reflect the most basic operations of typical devices consuming the ephemeral, fungible commodity.

Certain further embodiments include metering consumption by the device of the ephemeral, fungible commodity. Such embodiments advantageously support determination of the consumption of the ephemeral, fungible commodity by the device.

Certain further embodiments of metering consumption include measuring consumption rate within a metering time interval, determining the cost to create a metering cost factor during the metering time interval and calculating a consumption cost for the device over the metering time interval. Such embodiments advantageously support the cost of the ephemeral, fungible commodity, as well as the consumption rate, and the metering time interval to calculate the consumption cost over the metering time interval.

Certain further embodiments of metering consumption include maintaining an accumulated cost for the device of the ephemeral, fungible commodity and updating the accumulated cost for the device of the ephemeral, fungible commodity based upon the consumption cost for the device consuming the ephemeral, fungible commodity over the metering time interval. Such embodiments advantageously support an accumulated cost for the device of the consumed ephemeral, fungible commodity.

Certain embodiments include the device consuming a second ephemeral, fungible commodity. The method of planning further includes planning based upon the knowledge interval collection comprising at least one knowledge interval of the first ephemeral, fungible commodity and based upon a second knowledge interval collection comprising at least one knowledge interval of the second ephemeral, fungible commodity. Planning further comprises determining the second ephemeral, fungible commodity needs over the planning time interval, and examining the knowledge interval collection based upon the first ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule. Such embodiments advantageously support planning based upon the forward pricing of both ephemeral, fungible commodities.

Certain further embodiment integrate the two knowledge interval collections into a single knowledge interval collection comprising at least one knowledge interval for each ephemeral, fungible commodity. Such embodiments advantageously support maintaining a single knowledge interval collection integrating the capabilities of separate knowledge interval collections for the two ephemeral, fungible commodities.

Certain embodiments include the device consuming the ephemeral, fungible commodity and generating a second ephemeral, fungible commodity. Device planning includes a planning method based upon the knowledge interval collection of the first ephemeral, fungible commodity with costs and a second knowledge interval collection of knowledge intervals of the second ephemeral, fungible commodity with prices. Operations include determining the second ephemeral, fungible commodity needs over the planning time interval and examining the knowledge interval collection based upon the first ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule. Such embodiments advantageously support planning for devices consuming one

ephemeral, fungible commodity and generating the second ephemeral, fungible commodity.

Certain embodiments include the device transporting a second ephemeral, fungible commodity. Device planning includes a planning method based upon the knowledge interval collection of the ephemeral, fungible commodity with costs and a second knowledge interval collection of knowledge intervals of the second ephemeral, fungible commodity with prices. Operations include determining the second ephemeral, fungible commodity needs over the planning time interval and examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule. Such embodiments advantageously support planning for devices consuming one ephemeral, fungible commodity and transporting the second ephemeral, fungible commodity.

Certain embodiments include a method of planning a device generating an ephemeral, fungible commodity based upon a knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a price. The method comprises determining the ephemeral, fungible commodity needs over the planning time interval and examining the knowledge interval collection based upon the ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule.

Such a method advantageously incorporates forward market pricing of the ephemeral, fungible commodity as represented by the knowledge intervals to create a device operating schedule.

Certain embodiments include a method of planning a device transporting an ephemeral, fungible commodity based upon a knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity

at a time interval containing a price. The method comprises determining the ephemeral, fungible commodity needs over a planning time interval and examining the knowledge interval collection based upon the ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule.

Such a method advantageously incorporates forward market pricing of the ephemeral, fungible commodity as represented by the knowledge intervals to create a device operating schedule.

Certain embodiments include electricity as a ephemeral, fungible commodity. Such embodiments advantageously relate to electrical power grids and devices on such grids. Certain further embodiments include DC electricity as an ephemeral, fungible commodity. Such embodiments further advantageously relate to electrical power grids and devices on such grids. Certain other further embodiments include AC electricity as an ephemeral, fungible commodity. Such embodiments further advantageously relate to electrical power grids and devices on such grids.

Certain embodiments include program operating systems comprised of program steps residing on at least one computer readable memory accessibly coupled to a computer in a computing system supporting planning a device as discussed above. Such embodiments advantageously support utilization of computers to implement such embodiments.

Certain further embodiments include program operating systems comprised of program steps residing on at least one computer readable memory accessibly coupled to a computer in a computing system supporting planning a device further supporting communication regarding the knowledge interval collection as discussed above. Such embodiments advantageously support communication with regards the knowledge intervals over time.

Certain other further embodiments include program operating systems comprised of program steps residing on at least one computer readable memory accessibly coupled to a computer in a computing system supporting planning a device further supporting communication regarding the bid interval collection as discussed above. Such embodiments advantageously support trading of the ephemeral, fungible commodities as part of the planning operations of the device.

Certain further embodiments include program operating systems comprised of program steps residing on at least one computer readable memory accessibly coupled to a computer in a computing system supporting planning and operating a device as discussed above. Such embodiments advantageously include the operation as well as the planning of the device.

Certain embodiments advantageously support the operations discussed herein as program steps included in a program operating system executed by a computing system including at least one computer with coupled computer readable memory. The program steps are not required to all belong to the same instruction execution family, they may advantageously include program steps executing on multiple computers. The computing system may advantageously further include a client computer collection and a server system coupled by a network. The network may advantageously couple with specific client computers continuously or sporadically. The server system includes at least one server computer with accessibly coupled computer memory. In certain further embodiments, the server system advantageously includes multiple server computers coupled to the network, each with coupled accessible computer memory. In certain further embodiments, the server system supports redundant program steps maintaining various parts or all of the virtual trading floor for the ephemeral, fungible commodities.

These and other advantages of the present invention will become apparent upon reading the following detailed descriptions and studying the various figures of the drawings.

Brief Description of the Drawings

Figure **1** depicts an exemplary AC power network based upon contemporary AC power technology as found in the prior art;

Figure **2** depicts a list of associated AC power functions for each flow gate of a collection of flow gates for each of the busses of the various nodes of the exemplary AC power network of Figure **1** as disclosed in the prior art;

Figure **3A** depicts a virtual trading floor **1000**, containing validated orders and market intervals with associated market states in accordance with certain embodiments;

Figure **3B** depicts a market interval containing a product type, location and time interval in accordance with certain embodiments;

Figure **3C** depicts a refinement of a market interval as depicted in Figure **3B** further containing multiple time intervals in accordance with certain embodiments;

Figure **3A** depicts a virtual trading floor **1000**, containing validated orders and market intervals with associated market states in accordance with certain embodiments;

Figure **3B** depicts a market interval containing a product type, location and time interval in accordance with certain embodiments; The product types include ephemeral, fungible commodities in certain embodiments; In certain further embodiments, all product types are ephemeral, fungible commodities;

Figure **3C** depicts a refinement of a market interval as depicted in Figure **3B** further containing multiple time intervals in accordance with certain embodiments;

Figure **4A** depicts a flowchart of a method of planning a device consuming an ephemeral, fungible commodity based upon a knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a cost, in accordance with certain embodiments;

Figure **4B** depicts a detail flowchart of operation **2000** of Figure **4A** further performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection in accordance with certain embodiments;

Figure **5A** depicts a detail flowchart of operation **2032** of Figure **4B** further performing receiving knowledge interval creation messages and creating knowledge intervals in accordance with certain embodiments;

Figure **5B** depicts a detail flowchart of operation **2056** of Figure **5A** further performing processing the received knowledge interval creation message and inserting the first knowledge interval into the knowledge interval collection in accordance with certain embodiments;

Figure **6A** depicts a knowledge interval collection **1200** containing a knowledge interval **1210** in accordance with certain embodiments;

Figure **6B** depicts a knowledge interval collection **1200** containing no knowledge intervals in accordance with certain embodiments;

Figure **6C** depicts a knowledge interval collection **1200** containing knowledge intervals **1210**, **1220** in accordance with certain embodiments;

Figure **6D** depicts a second knowledge interval collection **1202** containing knowledge intervals **1230** and **1240**, in accordance with certain embodiments;

Figure **7A** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, a time interval **1214** and cost **1216** in accordance with certain embodiments;

Figure **7B** depicts a knowledge interval **1210** may contain no explicit reference to an ephemeral, fungible commodity, a time interval **1214** and cost **1216** in accordance with certain embodiments;

Figure **7C** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, a time interval collection **1218** and cost **1216** in accordance with certain embodiments;

Figure **7D** depicts a time interval collection **1218** containing time intervals **1214-1** and **1214-2** in accordance with certain embodiments;

Figure **8A** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, a time interval **1214** and price **1216-1** in accordance with certain embodiments;

Figure **8B** depicts a knowledge interval **1210** may contain no explicit reference to an ephemeral, fungible commodity, a time interval **1214** and price **1216-1** in accordance with certain embodiments;

Figure **8C** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, a time interval collection **1218** and price **1216-1** in accordance with certain embodiments;

Figure **9A** depicts a detail flowchart of operation **2056** of Figure **5A** performing replacing the second knowledge interval with the first knowledge interval in the

knowledge interval collection, wherein the first and second knowledge intervals share the same time interval, in accordance with certain embodiments;

Figure **9B** depicts a detail flowchart of operation **2056** of Figure **5A** further performing modifying a second knowledge interval to trim its time interval or time interval collection and insert the first time interval, when the first time interval of the first knowledge interval would intersect with the time interval(s) of the second knowledge interval already contain in the knowledge interval collection, in accordance with certain embodiments;

Figure **10A** depicts a detail flowchart of operation **2056** of Figure **5A** performing deleting the second knowledge interval from the knowledge interval in accordance with certain embodiments, when the second time interval is more than contained in the first time interval;

Figure **10B** depicts a flowchart performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection in accordance with certain embodiments;

Figure **11A** depicts a detail flowchart of operation **2154** of Figure **10B** further performing receiving and processing a knowledge interval removal message in accordance with certain embodiments;

Figure **11B** depicts a flowchart performing establishing a real time, in accordance with certain embodiments;

Figure **12A** depicts a detail flowchart of operation **2154** of Figure **10B** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection whenever the first time interval of the first knowledge interval precedes the real time in accordance with certain embodiments;

Figure **12B** depicts a detail flowchart of operation **2216** of Figure **12A** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection whenever the first time interval of the first knowledge interval precedes the real time in accordance with certain embodiments;

Figure **13A** depicts a flowchart performing receiving and processing a knowledge message in accordance with certain embodiments;

Figure **13B** depicts a detail flowchart of operation **2258** of Figure **13A** further performing processing the first received knowledge message in accordance with certain embodiments;

Figure **14A** depicts a detail flowchart of operation **2276** of Figure **13B** further performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message is create_knowledge_interval in accordance with certain embodiments;

Figure **14B** depicts a detail flowchart of operation **2280** of Figure **13B** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message is remove_knowledge_interval in accordance with certain embodiments;

Figure **15A** depicts a detail flowchart of operation **2272** of Figure **13B** performing examining the first received knowledge message to create a message type containing at least one member of the knowledge message type collection in accordance with certain embodiments;

Figure **15B** depicts a detail flowchart of operation **2276** of Figure **13B** performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains create_knowledge_interval in accordance with certain embodiments;

Figure **15C** depicts a detail flowchart of operation **2280** of Figure **13B** performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains remove_knowledge_interval in accordance with certain embodiments;

Figure **16A** depicts a detail flowchart of operation **2352** of Figure **15B** further performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains create_knowledge_interval in accordance with certain embodiments;

Figure **16B** depicts a detail flowchart of operation **2372** of Figure **15C** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains remove_knowledge_interval in accordance with certain embodiments;

Figure **17A** depicts a flowchart performing maintaining a bid interval collection of bid intervals in accordance with certain embodiments;

Figure **17B** depicts a detail flowchart of operation **2434** of Figure **17A** performing maintaining a bid interval collection of bid intervals in accordance with certain embodiments;

Figure **18A** depicts a bid interval collection **1300** containing a bid interval **1310** in accordance with certain embodiments;

Figure **18B** depicts a bid interval collection **1300** containing no bid intervals in accordance with certain embodiments;

Figure **18C** depicts a bid interval collection **1300** containing bid intervals **1310** and **1320** in accordance with certain embodiments;

Figure **18D** depicts a second bid interval collection **1302** containing bid intervals **1330** and **1340** in accordance with certain embodiments;

Figure **19A** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** in accordance with certain embodiments;

Figure **19B** depicts a bid interval **1310** may contain no explicit reference to an ephemeral, fungible bid commodity, bid time interval **1314**, bid price **1316** and bid amount **1316-1** in accordance with certain embodiments;

Figure **19C** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** in accordance with certain embodiments;

Figure **19D** depicts bid time interval collection **1318** containing bid time intervals **1314-1** and **1314-2** in accordance with certain embodiments;

Figure **20A** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** in accordance with certain embodiments;

Figure **20B** depicts a bid interval **1310** may contain no explicit reference to an ephemeral, fungible bid commodity, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** in accordance with certain embodiments;

Figure **20C** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** in accordance with certain embodiments;

Figure **21A** depicts a detail flowchart of operation **2032** of Figure **4B** performing creating the first knowledge interval of the knowledge interval collection based upon the first committed bid interval of the bid interval collection in accordance with certain embodiments;

Figure **21B** depicts a detail flowchart of operation **2472** of Figure **21A** further performing creating the first knowledge interval of the knowledge interval collection based upon the first committed bid interval of the bid interval collection in accordance with certain embodiments;

Figure **22A** depicts an equipment usage collection **1400** containing an equipment usage entry **1410** in accordance with certain embodiments;

Figure **22B** depicts an equipment usage collection **1400** containing no equipment usage entries in accordance with certain embodiments;

Figure **22C** depicts an equipment usage collection **1400** containing equipment usage entries **1410**, **1420** in accordance with certain embodiments;

Figure **22D** depicts a second equipment usage collection **1402** containing equipment usage entries **1430** and **1440**, in accordance with certain embodiments;

Figure **23A** depicts an equipment usage entry **1410** containing an ephemeral, fungible commodity **1412**, need schedule **1416** and delivery time **1414** in accordance with certain embodiments;

Figure **23B** depicts an equipment usage entry **1410** may contain no explicit reference to an ephemeral, fungible commodity, need schedule **1416** and delivery time **1414** in accordance with certain embodiments;

Figure **23C** depicts an equipment usage entry **1410** containing an ephemeral, fungible commodity **1412**, need schedule collection **1418** and delivery time 1414 in accordance with certain embodiments;

Figure **23D** depicts need schedule collection **1418** containing need schedules **1414-1** and **1414-2** in accordance with certain embodiments;

Figure **24A** depicts a commodity need **1510** containing an ephemeral, fungible commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1** in accordance with certain embodiments;

Figure **24B** depicts a commodity need **1510** may contain no explicit reference to an ephemeral, fungible commodity nor need time interval **1514** nor cost limit **1516** but possessing amount **1516-1** in accordance with certain embodiments;

Figure **24C** depicts a commodity need **1510** containing an ephemeral, fungible commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1** in accordance with certain embodiments;

Figure **24D** depicts need time interval collection **1518** containing need time intervals **1514-1** and **1514-2** in accordance with certain embodiments;

Figure **25A** depicts a commodity need collection **1500** containing a commodity need **1510** in accordance with certain embodiments;

Figure **25B** depicts a commodity need collection **1500** containing no commodity needs in accordance with certain embodiments;

Figure **25C** depicts a commodity need collection **1500** containing commodity needs **1510**, **1520** in accordance with certain embodiments;

Figure **25D** depicts a second commodity need collection **1502** containing commodity needs **1530** and **1540**, in accordance with certain embodiments;

Figure **26A** depicts a detail flowchart of operation **2004** of Figure **4A** further performing determining the ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments;

Figure **26B** depicts a detail flowchart of operation **2452** of Figure **17B** performing making the first bid of the first bid amount at the first bid price for the first time interval to create the first bid of the bid interval collection comprising the first bid amount as the bid amount; the first bid price as the bid price; the first time interval as the bid time interval in accordance with certain embodiments;

Figure **27A** depicts a detail flowchart of operation **2512** of Figure **26A** further performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs over the planning time interval to create the device operating schedule in accordance with certain embodiments;

Figure **27B** depicts a flowchart performing method of controlling the a device consuming the ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one of the knowledge intervals of the ephemeral, fungible commodity at the time interval containing the cost in accordance with certain embodiments;

Figure **28A** depicts an equipment usage plan **1600** containing an equipment usage item **1610** in accordance with certain embodiments;

Figure **28B** depicts an equipment usage plan **1600** containing no equipment usage items in accordance with certain embodiments;

Figure **28C** depicts an equipment usage plan **1600** containing equipment usage items **1610**, **1620** in accordance with certain embodiments;

Figure **28D** depicts a second equipment usage plan **1602** containing equipment usage items **1630** and **1640**, in accordance with certain embodiments;

Figure **29A** depicts an equipment usage item **1610** containing equipment identifier **1612**, activation time **1614** and action **1616** in accordance with certain embodiments;

Figure **29B** depicts an equipment usage item **1610** may contain no explicit reference to equipment identifier, activation time **1614** and action **1616** in accordance with certain embodiments;

Figure **29C** depicts action **1616** of Figures **29A** and **29B** can have a value belonging to an action collection comprising start-action **1616-1**, stop-action **1616-2** and throttle-action **1616-3**, in accordance with certain embodiments;

Figure **30** depicts a detail flowchart of operation **2574** of Figure **27B** further performing operating the device based upon the device operating schedule in accordance with certain embodiments;

Figure **31A** depicts a detail flowchart of operation **2602** of Figure **30** further performing starting the device based upon the device operating schedule in accordance with certain embodiments;

Figure **31B** depicts a detail flowchart of operation **2612** of Figure **30** further performing stopping the device based upon the device operating schedule in accordance with certain embodiments;

Figure **31C** depicts a detail flowchart of operation **2622** of Figure **30** further performing throttling the device based upon the device operating schedule in accordance with certain embodiments;

Figure **32A** depicts an equipment usage item comprised of an action **1616** and a throttle-setting **1616-10**;

Figure **32B** depicts a detail flowchart of operation **2622** of Figure **31C** further performing throttling the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of a throttle-action and the throttle-setting in accordance with certain embodiments;

Figure **32C** depicts a detail flowchart of operation **2632** of Figure **31A** performing starting the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of the start-action and the throttle-setting in accordance with certain embodiments;

Figure **33A** depicts a flowchart performing planning and controlling the device in accordance with certain embodiments, where the device includes a device collection comprised of at least two devices consuming the ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one of the knowledge intervals of the ephemeral, fungible commodity at the time interval containing the cost;

Figure **33B** depicts a detail flowchart of operation **2734** of Figure **33A** further performing operating the device collection based upon the device collection operating schedule comprises at least one of the collection in accordance with certain embodiments;

Figure **34A** depicts a flowchart performing metering consumption by the device of the ephemeral, fungible commodity in accordance with certain embodiments;

Figure **34B** depicts a detail flowchart of operation **2794** of Figure **34A** further performing metering consumption by the device of the ephemeral, fungible commodity in accordance with certain embodiments;

Figure **35** depicts a detail flowchart of operation **2794** of Figure **34A** further performing metering consumption by the device of the ephemeral, fungible commodity in accordance with certain embodiments;

Figure **36A** depicts a detail flowchart of operation **2000** of Figure **4A** further performing a method of planning the device consuming two ephemeral, fungible commodities based upon the knowledge interval collections comprising at least one knowledge interval of ephemeral, fungible commodities at a time interval containing a cost in accordance with certain embodiments;

Figure **36B** depicts a detail flowchart of operation **2004** of Figure **4A** performing determining the second ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments;

Figure **36C** depicts a detail flowchart of operation **2008** of Figure **4A** performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule in accordance with certain embodiments;

Figure **37A** depicts a detail flowchart of operation **2000** of Figure **4A** further performing a method of planning the device consuming ephemeral, fungible commodity and generating a second ephemeral, fungible commodity based upon the knowledge interval collections comprising at least one knowledge interval of

ephemeral, fungible commodities at a time interval containing a cost in accordance with certain embodiments;

Figure **37B** depicts a detail flowchart of operation **2004** of Figure **4A** performing determining the second ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments;

Figure **37C** depicts a detail flowchart of operation **2008** of Figure **4A** performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule in accordance with certain embodiments;

Figure **38A** depicts a detail flowchart of operation **2000** of Figure **4A** further performing a method of planning the device consuming ephemeral, fungible commodity and transporting a second ephemeral, fungible commodity based upon the knowledge interval collections comprising at least one knowledge interval of ephemeral, fungible commodities at a time interval containing a cost in accordance with certain embodiments;

Figure **38B** depicts a detail flowchart of operation **2004** of Figure **4A** performing determining the second ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments;

Figure **38C** depicts a detail flowchart of operation **2008** of Figure **4A** performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule in accordance with certain embodiments;

Figure **39A** shows an application of certain embodiments in a passive mode: it will link to the system for the price information and cannot trade in the market;

Figure **39B** shows an application of certain embodiments in an active mode: it will link to the system for the price and trade interactions in the market; and

Figure **40** depicts a simplified system block of a trading computing system **4000** supporting interaction between a collection of certified clients and a computing system based upon interactions involving a virtual trading floor in accordance with certain embodiments.

Detailed Description of the Invention

Figure **3A** depicts a virtual trading floor **1000**, containing validated orders and market intervals with associated market states in accordance with certain embodiments.

A virtual trading floor mechanism **1000** comprises a collection of market intervals, each with an associated market state, and validated orders. A market contains a product type and a location. Trading in the market is done in terms of market intervals **1100**, **1120**, **1140** and **1160**. Each market interval of a market contains the market product type, market location, plus a calendar scheme with an interval end. The market state of a market interval comprises a market price for the market interval product type at the market interval location during the market interval time interval.

In certain further embodiments, a validated order contains an amount of the market interval product type and a price for the market interval product type. The validated order is either a bid order or an ask validated order.

In certain further embodiments, a virtual trading floor supports trading ephemeral, fungible commodities of an electrical power grid containing at least one AC power network. Each AC power network further contains a node collection of at least two nodes. In certain further embodiments, the product type of the market intervals of the market interval collection is a member of a product type collection

comprised of energy and AC power transfer. In certain further embodiments, the location of a market interval having an energy product type is a first node of the node collection of an AC power network contained in the electrical power grid. In certain further embodiments, the location of a market interval having an AC power transfer product type is from a first node of a first AC power network contained in the electrical power grid to a second node of the first AC power network.

Figure **3B** depicts a market interval containing a product type, location and time interval in accordance with certain embodiments. The product types include ephemeral, fungible commodities in certain embodiments. In certain further embodiments, all product types are ephemeral, fungible commodities.

In certain embodiments, location refers to a single node. In certain embodiments, a node may be specified geographically. In certain embodiments, a node may be specified in terms of nodes in a network, containing both a collection of nodes and a collection of lines, each line from a first node to a second node. Note that the term line as used herein does not exclusively imply a straight line. In certain embodiments, a node may be specified in terms of a node of a network contained in a grid of one or more network, which may further contain special lines connecting nodes of potentially distinct networks.

In certain further embodiments, location may additionally refer to a transition or transfer from a first node to a second node. As discussed above, such a transition in a network would correspond to a line between the first node and the second node.

Figure **3C** depicts a refinement of a market interval as depicted in Figure **3B** further containing multiple time intervals in accordance with certain embodiments. In this figure, two time intervals are depicted by way of example. In certain embodiments, more than two time intervals may be contained in one market interval. In certain further embodiments, each of the multiple time

intervals does not temporally overlap the other contained time intervals of the market interval.

Figure **4A** depicts a flowchart of a method of planning a device consuming an ephemeral, fungible commodity based upon a knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a cost, in accordance with certain embodiments.

Operation **2000** starts the operations of this flowchart. Arrow **2002** directs the flow of execution from operation **2000** to operation **2004**. Operation **2004** performs determining the ephemeral, fungible commodity needs over a planning time interval. Arrow **2006** directs execution from operation **2004** to operation **2008**. Operation **2008** performs examining the knowledge interval collection based upon the ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule. Arrow **2010** directs execution from operation **2008** to operation **2012**. Operation **2012** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting the virtual trading floor for ephemeral, fungible commodities.

As used herein, the term computer refers to devices including instruction set computers, inferential computers, and analog computers, as well as aggregates of these basic kinds of computers. A computer will also refer to informational appliances incorporating one or more computers in their construction. Such informational appliances may be physically distinct units, or they may be tangibly integrated into other devices, or they may be tangibly integrated into the physically mobile neighborhood of one or more human beings.

As used herein, certain computers, including instruction-processing computers and inferential computers include coupled computer readable memory to hold what will be termed herein as instructions. Instructions as used herein with regard to instruction set computers will refer to information controlling state transition of such instruction computers. Based upon the current individual or collection of instructions being executed, and its internal state, the instruction-processing computer will determine the future state of the instruction-processing computer. Note that these instructions may either be directly executed by the instruction-processing computer or may be interpretively executed by the instruction-processing computer.

Instructions as used herein with regard to inferential computers will refer to information presented to the inferential computer used to infer the future state of the computer based upon an inference base of the inferential computer directed by the presented instruction. Such an inference base may reside internal to the inferential computer in certain cases, or reside in coupled computer accessible memory, which may be both read and written by the inferential computer. Note that inferential computers include but are not limited to machines executing various forms of Horn clause predicates as well as constraint rules, pattern recognition templates, fractal pattern templates and fuzzy logic predicate structural elements.

Analog computers as used herein include, but are not limited to, devices directly coupling to analog circuitry. Such analog circuitry as used herein includes, but is not limited to, radio frequency IF stages, opto-electronic interfaces such as lasers embedded in fiber optic communications systems, audio and video pattern recognition circuitry, audio and video output devices. Analog computers as used herein include but are not limited to acoustic interfaces to humans, audio and visual identification portals to the contracting of AC power transfer regarding flow gates, encoding and decoding mechanisms used in long distance communication and interfaces to recording devices of agreed contracts.

A program step as used herein refers to instructions in a form that either by execution or by inference directs the computer coupled to the computer readable memory in which the program step resides. Note that in certain embodiments, program steps may be native executable instructions of an instruction-processing computer. In certain other embodiments, program steps may be interpretively executed instructions of an instruction-processing computer.

Figure **4B** depicts a detail flowchart of operation **2000** of Figure **4A** further performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection in accordance with certain embodiments.

Arrow **2030** directs the flow of execution from starting operation **2000** to operation **2032**. Operation **2032** performs creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection. Arrow **2034** directs execution from operation **2032** to operation **2036**. Operation **2036** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **5A** depicts a detail flowchart of operation **2032** of Figure **4B** further performing receiving knowledge interval creation messages and creating knowledge intervals in accordance with certain embodiments.

Arrow **2050** directs the flow of execution from starting operation **2032** to operation **2052**. Operation **2052** performs receiving a knowledge interval creation message to create a received knowledge interval creation message. Arrow **2054** directs execution from operation **2052** to operation **2056**. Operation **2056** performs creating the first knowledge interval of the ephemeral, fungible

commodity at the first time interval containing the first cost in the knowledge interval collection based upon the received knowledge interval creation message. Arrow **2058** directs execution from operation **2056** to operation **2060**. Operation **2060** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **5B** depicts a detail flowchart of operation **2056** of Figure **5A** further performing processing the received knowledge interval creation message and inserting the first knowledge interval into the knowledge interval collection in accordance with certain embodiments.

Arrow **2070** directs the flow of execution from starting operation **2056** to operation **2072**. Operation **2072** performs processing the received knowledge interval creation message to create a processed knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost. Arrow **2074** directs execution from operation **2072** to operation **2076**. Operation **2076** performs inserting the processed knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost into the knowledge interval collection as the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost. Arrow **2078** directs execution from operation **2076** to operation **2080**. Operation **2080** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **6A** depicts a knowledge interval collection **1200** containing a knowledge interval **1210** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval collection **1200** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval collection **1200** may be implemented as a table containing a knowledge interval **1210** as an entry in the table. In certain other further embodiments, knowledge interval collection **1200** may be implemented as a record structure instance containing a pointer to a record structure instance of knowledge interval **1210**. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing reference to an object class instance of knowledge interval **1210**. In certain further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing a pointer reference to an object class instance of knowledge interval **1210**. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing a handle reference to an object class instance of knowledge interval **1210**.

Figure **6B** depicts a knowledge interval collection **1200** containing no knowledge intervals in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval collection **1200** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval collection **1200** may be implemented as a table containing no knowledge interval entries in the table. In certain other further embodiments, knowledge interval collection **1200** may be implemented as a record structure instance containing no pointers to record structure instances of a knowledge interval. In certain further embodiments, knowledge interval collection **1200** may be implemented as a record structure instance containing a null pointer to a record structure instance of a knowledge interval. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing no references to an object class instance of a knowledge interval. In certain other further embodiments, knowledge interval

collection **1200** may be implemented as an object instance containing a null reference to an object class instance of a knowledge interval. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing no pointer reference to an object class instance of a knowledge interval. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing a null pointer reference to an object class instance of a knowledge interval. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing no handle references to an object class instance of a knowledge interval. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing a null handle reference to an object class instance of a knowledge interval.

Figure **6C** depicts a knowledge interval collection **1200** containing knowledge intervals **1210**, **1220** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval collection **1200** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval collection **1200** may be implemented as a table containing knowledge intervals **1210** and **1220** as entries in the table. In certain other further embodiments, knowledge interval collection **1200** may be implemented as a record structure instance containing pointers to record structure instances of knowledge intervals **1210** and **1220**. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing references to an object class instance of knowledge intervals **1210** and **1220**. In certain further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing pointer references to an object class instance of knowledge intervals **1210** and **1220**. In certain other further embodiments, knowledge interval collection **1200** may be implemented as an object instance containing a handle reference to an object

class instance of knowledge intervals **1210** and **1220**. In certain other embodiments, knowledge interval collection **1200** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of knowledge intervals **1210** and **1220**. In a similar fashion, object instances of **1200** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain knowledge intervals **1210** and **1220**.

In certain embodiments, more than two knowledge intervals may be contained in knowledge interval collection **1200**. In certain embodiments, knowledge interval collections may be implemented as collections of inferential clauses, wherein a knowledge interval may in turn be represented as a collection of inferential clauses.

Figure **6D** depicts a second knowledge interval collection **1202** containing knowledge intervals **1230** and **1240**, in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval collection **1202** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval collection **1202** may be implemented as a table containing knowledge intervals **1230** and **1240** as entries in the table. In certain other further embodiments, knowledge interval collection **1202** may be implemented as a record structure instance containing pointers to record structure instances of knowledge intervals **1230** and **1240**. In certain other further embodiments, knowledge interval collection **1202** may be implemented as an object instance containing references to an object class instance of knowledge intervals **1230** and **1240**. In certain further embodiments, knowledge interval collection **1202** may be implemented as an object instance containing pointer references to an object class instance of knowledge intervals **1230** and **1240**. In certain other further embodiments, knowledge interval collection **1202** may be implemented as an object instance containing a handle reference to an object

class instance of knowledge intervals **1230** and **1240**. In certain other embodiments, knowledge interval collection **1202** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of knowledge intervals **1230** and **1240**. In a similar fashion, object instances of **1202** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain knowledge intervals **1230** and **1240**.

In certain embodiments, more than two knowledge intervals may be contained in knowledge interval collection **1202**. In certain embodiments, only one knowledge interval may be contained in knowledge interval collection **1202**. In certain embodiments, no knowledge intervals may be contained in knowledge interval collection **1202**. In certain embodiments, knowledge interval collections may be implemented as collections of inferential clauses, wherein a knowledge interval may in turn be represented as a collection of inferential clauses. In certain embodiments, more than two knowledge interval collections may be implemented.

Figure **7A** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, time interval **1214** and cost **1216** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval **1210** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval **1210** may be implemented as a table containing a commodity **1212**, time interval **1214** and cost **1216** as an entry in the table. In certain other further embodiments, knowledge interval **1210** may be implemented as a record structure instance containing a pointer to record structure instances of commodity **1212**, time interval **1214** and cost **1216**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing references to object class instances of

commodity **1212**, time interval **1214** and cost **1216**. In certain further embodiments, knowledge interval **1210** may be implemented as an object instance containing pointer references to object class instances of commodity **1212**, time interval **1214** and cost **1216**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing handle references to object class instances of commodity **1212**, time interval **1214** and cost **1216**.

Note that in certain embodiments, a knowledge interval collection **1200** may include, but is not limited to, knowledge intervals **1210** and **1220** containing different ephemeral, fungible commodities. In certain other embodiments, a knowledge interval collection may additionally include, but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities.

Figure **7B** depicts a knowledge interval **1210** may contain no explicit reference to an ephemeral, fungible commodity, time interval **1214** and cost **1216** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval **1210** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval **1210** may be implemented as a table containing a commodity **1212**, time interval **1214** and cost **1216** as an entry in the table. In certain other further embodiments, knowledge interval **1210** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1212**, time interval **1214** and cost **1216**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing references to object class instances of commodity **1212**, time interval **1214** and cost **1216**. In certain further embodiments, knowledge interval **1210** may be implemented as an object instance containing pointer references to object class instances of commodity

1212, time interval **1214** and cost **1216**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing handle references to object class instances of commodity **1212**, time interval **1214** and cost **1216**.

Note that in certain embodiments, a knowledge interval collection **1200** may include, but is not limited to, knowledge intervals **1210** and **1220** containing different ephemeral, fungible commodities, not possessing explicit commodity designation **1212**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, a knowledge interval collection may additionally include, but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities, not possessing explicit commodity designation **1212**, but surmised by inclusion in distinct tables, linked lists and the like.

Figure **7C** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, time interval collection **1218** and cost **1216** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval **1210** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval **1210** may be implemented as a table containing a commodity **1212**, time interval collection **1218** and cost **1216** as an entry in the table. In certain other further embodiments, knowledge interval **1210** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1212**, time interval collection **1218** and cost **1216**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing references to object class instances of commodity **1212**, time interval collection **1218** and cost **1216**. In certain further embodiments, knowledge interval **1210** may be implemented as an object instance containing pointer references to object class instances of

commodity **1212**, time interval collection **1218** and cost **1216**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing handle references to object class instances of commodity **1212**, time interval collection **1218** and cost **1216**.

Note that in certain embodiments, a knowledge interval collection **1200** may include, but is not limited to, knowledge intervals **1210** and **1220** containing different ephemeral, fungible commodities. In certain other embodiments, a knowledge interval collection may additionally include, but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities.

In certain other embodiments, knowledge interval **1210** may contain no explicit reference to an ephemeral, fungible commodity, a time interval **1214** and cost **1216** as discussed above.

Figure **7D** depicts time interval collection **1218** containing time intervals **1214-1** and **1214-2** in accordance with certain embodiments.

Note that in certain embodiments, time interval collection **1218** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, time interval collection **1218** may be implemented as a table containing time intervals **1214-1** and **1214-2** as entries in the table. In certain other further embodiments, time interval collection **1218** may be implemented as a record structure instance containing pointers to record structure instances of time intervals **1214-1** and **1214-2**. In certain other further embodiments, time interval collection **1218** may be implemented as an object instance containing references to object class instances of time intervals **1214-1** and **1214-2**. In certain further embodiments, time interval collection **1218** may be implemented as an object instance containing pointer references to object class instances of time intervals **1214-1** and **1214-2**. In certain other further embodiments, time interval collection **1218** may be implemented as an object

instance containing handle references to object class instances of time intervals **1214-1** and **1214-2**.

Note that in certain embodiments, a time interval collection **1218** may include, but is not limited to, one time interval **1214-1**. In certain embodiments, a time interval collection **1218** may include, but is not limited to, more than two time intervals.

Figure **8A** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, time interval **1214** and price **1216-1** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval **1210** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval **1210** may be implemented as a table containing a commodity **1212**, time interval **1214** and price **1216-1** as an entry in the table. In certain other further embodiments, knowledge interval **1210** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1212**, time interval **1214** and price **1216-1**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing references to object class instances of commodity **1212**, time interval **1214** and price **1216-1**. In certain further embodiments, knowledge interval **1210** may be implemented as an object instance containing pointer references to object class instances of commodity **1212**, time interval **1214** and price **1216-1**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing handle references to object class instances of commodity **1212**, time interval **1214** and price **1216-1**.

Note that in certain embodiments, a knowledge interval collection **1200** may include, but is not limited to, knowledge intervals **1210** and **1220** containing different ephemeral, fungible commodities. In certain other embodiments, a knowledge interval collection may additionally include, but is not limited to,

knowledge intervals for commodities which are not ephemeral, fungible commodities.

Figure **8B** depicts a knowledge interval **1210** may contain no explicit reference to an ephemeral, fungible commodity, time interval **1214** and price **1216-1** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval **1210** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval **1210** may be implemented as a table containing a commodity **1212**, time interval **1214** and price **1216-1** as an entry in the table. In certain other further embodiments, knowledge interval **1210** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1212**, time interval **1214** and price **1216-1**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing references to object class instances of commodity **1212**, time interval **1214** and price **1216-1**. In certain further embodiments, knowledge interval **1210** may be implemented as an object instance containing pointer references to object class instances of commodity **1212**, time interval **1214** and price **1216-1**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing handle references to object class instances of commodity **1212**, time interval **1214** and price **1216-1**.

Note that in certain embodiments, a knowledge interval collection **1200** may include, but is not limited to, knowledge intervals **1210** and **1220** containing different ephemeral, fungible commodities, not possessing explicit commodity designation **1212**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, a knowledge interval collection may additionally include, but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities. In certain further embodiments,

a knowledge interval collection may additionally include, but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities, that do not possess an explicit commodity designation, but which is surmised by inclusion in distinct tables, linked lists and the like.

Figure **8C** depicts a knowledge interval **1210** containing an ephemeral, fungible commodity **1212**, time interval collection **1218** and price **1216-1** in accordance with certain embodiments.

Note that in certain embodiments, knowledge interval **1210** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, knowledge interval **1210** may be implemented as a table containing a commodity **1212**, time interval collection **1218** and price **1216-1** as an entry in the table. In certain other further embodiments, knowledge interval **1210** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1212**, time interval collection **1218** and price **1216-1**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing references to object class instances of commodity **1212**, time interval collection **1218** and price **1216-1**. In certain further embodiments, knowledge interval **1210** may be implemented as an object instance containing pointer references to object class instances of commodity **1212**, time interval collection **1218** and price **1216-1**. In certain other further embodiments, knowledge interval **1210** may be implemented as an object instance containing handle references to object class instances of commodity **1212**, time interval collection **1218** and price **1216-1**.

Note that in certain embodiments, a knowledge interval collection **1200** may include, but is not limited to, knowledge intervals **1210** and **1220** containing different ephemeral, fungible commodities. In certain other embodiments, a knowledge interval collection may additionally include, but is not limited to,

knowledge intervals for commodities which are not ephemeral, fungible commodities.

In certain other embodiments, knowledge interval **1210** may contain no explicit reference to an ephemeral, fungible commodity, a time interval **1214** and price **1216-1** as discussed above.

Figure **9A** depicts a detail flowchart of operation **2056** of Figure **5A** performing replacing the second knowledge interval with the first knowledge interval in the knowledge interval collection, wherein the first and second knowledge intervals share the same time interval, in accordance with certain embodiments.

Arrow **2090** directs the flow of execution from starting operation **2056** to operation **2092**. Operation **2092** performs replacing the second knowledge interval with the first knowledge interval in the knowledge interval collection. Arrow **2094** directs execution from operation **2092** to operation **2096**. Operation **2096** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **9B** depicts a detail flowchart of operation **2056** of Figure **5A** further performing modifying a second knowledge interval to trim its time interval or time interval collection and insert the first time interval, when the first time interval of the first knowledge interval would intersect with the time interval(s) of the second knowledge interval already contained in the knowledge interval collection, in accordance with certain embodiments.

Arrow **2110** directs the flow of execution from starting operation **2056** to operation **2112**. Operation **2112** performs determining a remaining time interval collection of at least one remaining time interval wherein the remaining time

intervals collectively exactly contain the second time interval not contained in the first time interval. Arrow **2114** directs execution from operation **2112** to operation **2116**. Operation **2116** performs replacing the second time interval of the second knowledge interval with the remaining time interval collection in the knowledge interval collection. Arrow **2118** directs execution from operation **2116** to operation **2120**. Operation **2120** performs inserting the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost. Arrow **2122** directs execution from operation **2120** to operation **2124**. Operation **2124** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **10A** depicts a detail flowchart of operation **2056** of Figure **5A** performing deleting the second knowledge interval from the knowledge interval in accordance with certain embodiments, when the second time interval is more than contained in the first time interval.

Arrow **2130** directs the flow of execution from starting operation **2056** to operation **2132**. Operation **2132** performs deleting the second knowledge interval from the knowledge interval. Arrow **2134** directs execution from operation **2132** to operation **2136**. Operation **2136** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **10B** depicts a flowchart performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first

cost from the knowledge interval collection in accordance with certain embodiments.

Operation **2150** starts the operations of this flowchart. Arrow **2152** directs the flow of execution from operation **2150** to operation **2154**. Operation **2154** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection. Arrow **2156** directs execution from operation **2154** to operation **2158**. Operation **2158** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **11A** depicts a detail flowchart of operation **2154** of Figure **10B** further performing receiving and processing a knowledge interval removal message in accordance with certain embodiments.

Arrow **2170** directs the flow of execution from starting operation **2154** to operation **2172**. Operation **2172** performs receiving a knowledge interval removal message to create a received knowledge interval removal message. Arrow **2174** directs execution from operation **2172** to operation **2176**. Operation **2176** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection based upon the received knowledge interval removal message. Arrow **2178** directs execution from operation **2176** to operation **2180**. Operation **2180** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **11B** depicts a flowchart performing establishing a real time, in accordance with certain embodiments.

Operation **2190** starts the operations of this flowchart. Arrow **2192** directs the flow of execution from operation **2190** to operation **2194**. Operation **2194** performs establishing a real time. Arrow **2196** directs execution from operation **2194** to operation **2198**. Operation **2198** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **12A** depicts a detail flowchart of operation **2154** of Figure **10B** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection whenever the first time interval of the first knowledge interval precedes the real time in accordance with certain embodiments.

Arrow **2210** directs the flow of execution from starting operation **2154** to operation **2212**. Operation **2212** performs determining whether the first time interval of the first knowledge interval precedes the real time. Arrow **2214** directs execution from operation **2212** to operation **2216**. Operation **2216** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection whenever the first time interval of the first knowledge interval precedes the real time. Arrow **2218** directs execution from operation **2216** to operation **2220**. Operation **2220** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **12B** depicts a detail flowchart of operation **2216** of Figure **12A** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection whenever the first time interval of the first knowledge interval precedes the real time in accordance with certain embodiments.

Arrow **2230** directs the flow of execution from starting operation **2216** to operation **2232**. Operation **2232** determines whenever the first time interval of the first knowledge interval precedes the real time. Arrow **2234** directs execution from operation **2232** to operation **2236** when the determination is 'Yes'. Arrow **2248** directs execution to **2240** when the determination is 'No'.

Operation **2236** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost from the knowledge interval collection. Arrow **2238** directs execution from operation **2236** to operation **2240**. Operation **2240** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **13A** depicts a flowchart performing receiving and processing a knowledge message in accordance with certain embodiments.

Operation **2250** starts the operations of this flowchart. Arrow **2252** directs the flow of execution from operation **2250** to operation **2254**. Operation **2254** performs receiving a first knowledge message to create a first received knowledge message. Arrow **2256** directs execution from operation **2254** to operation **2258**. Operation **2258** performs processing the first received knowledge message. Arrow **2260** directs execution from operation **2258** to operation **2262**. Operation **2262** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **13B** depicts a detail flowchart of operation **2258** of Figure **13A** further performing processing the first received knowledge message in accordance with certain embodiments.

Arrow **2270** directs the flow of execution from starting operation **2258** to operation **2272**. Operation **2272** performs examining the first received knowledge message to create a message type belonging to a knowledge message type collection comprising create_knowledge_interval, remove_knowledge_interval. Arrow **2274** directs execution from operation **2272** to operation **2276**. Operation **2276** performs creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message is create_knowledge_interval. Arrow **2278** directs execution from operation **2276** to operation **2280**. Operation **2280** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message is remove_knowledge_interval. Arrow **2282** directs execution from operation **2280** to operation **2284**. Operation **2284** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **14A** depicts a detail flowchart of operation **2276** of Figure **13B** further performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval

collection based upon the first received knowledge message whenever the message type of the first received knowledge message is create_knowledge_interval in accordance with certain embodiments.

Arrow **2290** directs the flow of execution from starting operation **2276** to operation **2292**. Operation **2292** determines whenever the message type of the first received knowledge message is create_knowledge_interval. Arrow **2294** directs execution from operation **2292** to operation **2296** when the determination is 'Yes'. Arrow **2308** directs execution to **2300** when the determination is 'No'.

Operation **2296** performs creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message. Arrow **2298** directs execution from operation **2296** to operation **2300**. Operation **2300** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **14B** depicts a detail flowchart of operation **2280** of Figure **13B** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message is remove_knowledge_interval in accordance with certain embodiments.

Arrow **2310** directs the flow of execution from starting operation **2280** to operation **2312**. Operation **2312** determines whenever the message type of the first received knowledge message is remove_knowledge_interval. Arrow **2314** directs execution from operation **2312** to operation **2316** when the determination is 'Yes'. Arrow **2328** directs execution to **2320** when the determination is 'No'.

Operation **2316** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message. Arrow **2318** directs execution from operation **2316** to operation **2320**. Operation **2320** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **15A** depicts a detail flowchart of operation **2272** of Figure **13B** performing examining the first received knowledge message to create a message type containing at least one member of the knowledge message type collection in accordance with certain embodiments.

Arrow **2330** directs the flow of execution from starting operation **2272** to operation **2332**. Operation **2332** performs examining the first received knowledge message to create a message type containing at least one member of the knowledge message type collection. Arrow **2334** directs execution from operation **2332** to operation **2336**. Operation **2336** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **15B** depicts a detail flowchart of operation **2276** of Figure **13B** performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains create_knowledge_interval in accordance with certain embodiments.

Arrow **2350** directs the flow of execution from starting operation **2276** to operation **2352**. Operation **2352** performs creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains create_knowledge_interval. Arrow **2354** directs execution from operation **2352** to operation **2356**. Operation **2356** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **15C** depicts a detail flowchart of operation **2280** of Figure **13B** performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains remove_knowledge_interval in accordance with certain embodiments.

Arrow **2370** directs the flow of execution from starting operation **2280** to operation **2372**. Operation **2372** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains remove_knowledge_interval. Arrow **2374** directs execution from operation **2372** to operation **2376**. Operation **2376** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **16A** depicts a detail flowchart of operation **2352** of Figure **15B** further performing creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains create_knowledge_interval in accordance with certain embodiments.

Arrow **2390** directs the flow of execution from starting operation **2352** to operation **2392**. Operation **2392** determines whenever the message type of the first received knowledge message contains create_knowledge_interval. Arrow **2394** directs execution from operation **2392** to operation **2396** when the determination is 'Yes'. Arrow **2408** directs execution to **2400** when the determination is 'No'.

Operation **2396** performs creating a first knowledge interval of the ephemeral, fungible commodity at a first time interval containing a first cost in the knowledge interval collection based upon the first received knowledge message. Arrow **2398** directs execution from operation **2396** to operation **2400**. Operation **2400** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **16B** depicts a detail flowchart of operation **2372** of Figure **15C** further performing removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message whenever the message type of the first received knowledge message contains remove_knowledge_interval in accordance with certain embodiments.

Arrow **2410** directs the flow of execution from starting operation **2372** to operation **2412**. Operation **2412** determines whenever the message type of the first received knowledge message contains remove_knowledge_interval. Arrow **2414** directs execution from operation **2412** to operation **2416** when the determination is 'Yes'. Arrow **2428** directs execution to **2420** when the determination is 'No'.

Operation **2416** performs removing the first knowledge interval of the ephemeral, fungible commodity at the first time interval containing the first cost in the knowledge interval collection based upon the first received knowledge message. Arrow **2418** directs execution from operation **2416** to operation **2420**. Operation **2420** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **17A** depicts a flowchart performing maintaining a bid interval collection of bid intervals in accordance with certain embodiments.

Operation **2430** starts the operations of this flowchart. Arrow **2432** directs the flow of execution from operation **2430** to operation **2434**. Operation **2434** performs maintaining a bid interval collection of bid intervals. Arrow **2436** directs execution from operation **2434** to operation **2438**. Operation **2438** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **17B** depicts a detail flowchart of operation **2434** of Figure **17A** performing maintaining a bid interval collection of bid intervals in accordance with certain embodiments.

Arrow **2450** directs the flow of execution from starting operation **2434** to operation **2452**. Operation **2452** performs making a first bid of a first bid amount at a first bid price for a first time interval to create a first bid of the bid interval collection comprising the first bid amount as the bid amount, the first bid price as the bid price, and the first time interval as the bid time interval. Arrow **2454** directs execution from operation **2452** to operation **2456**. Operation **2456** terminates the operations of this flowchart.

Arrow **2460** directs the flow of execution from starting operation **2434** to operation **2462**. Operation **2462** performs committing of the first bid interval to create a committed first bid interval of the bid interval collection comprising the first bid amount as the bid amount, the first bid price as the bid price, the first time interval as the bid time interval and the committed flag. Arrow **2464** directs execution from operation **2462** to operation **2456**. Operation **2456** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **18A** depicts a bid interval collection **1300** containing a bid interval **1310** in accordance with certain embodiments.

Note that in certain embodiments, bid interval collection **1300** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval collection **1300** may be implemented as a table containing a bid interval **1310** as an entry in the table. In certain other further embodiments, bid interval collection **1300** may be implemented as a record

structure instance containing a pointer to a record structure instance bid interval **1310**. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing reference to an object class instance of bid interval **1310**. In certain further embodiments, bid interval collection **1300** may be implemented as an object instance containing a pointer reference to an object class instance of bid interval **1310**. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing a handle reference to an object class instance of bid interval **1310**.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **18B** depicts a bid interval collection **1300** containing no bid intervals in accordance with certain embodiments.

Note that in certain embodiments, bid interval collection **1300** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval collection **1300** may be implemented as a table containing no bid interval entries in the table. In certain other further embodiments, bid interval collection **1300** may be implemented as a record structure instance containing no pointers to record structure instances of a bid interval. In certain further embodiments, bid interval collection **1300** may be implemented as a record structure instance containing a null pointer to a record structure instance of bid interval. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing no references to an object class instance of bid interval. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing a null reference to an object class instance of bid interval. In certain other further embodiments, bid interval collection **1300** may be

implemented as an object instance containing no pointer reference to an object class instance of bid interval. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing a null pointer reference to an object class instance of bid interval. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing no handle references to an object class instance of bid interval. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing a null handle reference to an object class instance of bid interval.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **18C** depicts a bid interval collection **1300** containing bid intervals **1310**, **1320** in accordance with certain embodiments.

Note that in certain embodiments, bid interval collection **1300** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval collection **1300** may be implemented as a table containing bid intervals **1310** and **1320** as entries in the table. In certain other further embodiments, bid interval collection **1300** may be implemented as a record structure instance containing pointers to record structure instances bid intervals **1310** and **1320**. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing references to an object class instance of bid intervals **1310** and **1320**. In certain further embodiments, bid interval collection **1300** may be implemented as an object instance containing pointer references to an object class instance of bid intervals **1310** and **1320**. In certain other further embodiments, bid interval collection **1300** may be implemented as an object instance containing a handle reference to an object class instance of bid intervals **1310** and **1320**. In certain other

embodiments, bid interval collection **1300** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of bid intervals **1310** and **1320**. In a similar fashion, object instances of **1300** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain bid intervals **1310** and **1320**.

In certain embodiments, more than two bid intervals may be contained in bid interval collection **1300**. In certain embodiments, bid interval collections may be implemented as collections of inferential clauses, wherein a bid interval may in turn be represented as a collection of inferential clauses.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **18D** depicts a second bid interval collection **1302** containing bid intervals **1330** and **1340**, in accordance with certain embodiments.

Note that in certain embodiments, bid interval collection **1302** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval collection **1302** may be implemented as a table containing bid intervals **1330** and **1340** as entries in the table. In certain other further embodiments, bid interval collection **1302** may be implemented as a record structure instance containing pointers to record structure instances bid intervals **1330** and **1340**. In certain other further embodiments, bid interval collection **1302** may be implemented as an object instance containing references to an object class instance of bid intervals **1330** and **1340**. In certain further embodiments, bid interval collection **1302** may be implemented as an object instance containing pointer references to an object class instance of bid intervals **1330** and **1340**. In certain other further embodiments, bid interval collection **1302** may be implemented as an object instance containing a handle reference to an

object class instance of bid intervals **1330** and **1340**. In certain other embodiments, bid interval collection **1302** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of bid intervals **1330** and **1340**. In a similar fashion, object instances of **1302** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain bid intervals **1330** and **1340**.

In certain embodiments, more than two bid intervals may be contained in bid interval collection **1302**. In certain embodiments, only one bid interval may be contained in bid interval collection **1302**. In certain embodiments, no bid intervals may be contained in bid interval collection **1302**. In certain embodiments, bid interval collections may be implemented as collections of inferential clauses, wherein a bid interval may in turn be represented as a collection of inferential clauses. In certain embodiments, more than two bid interval collections may be implemented.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **19A** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** in accordance with certain embodiments.

Note that in certain embodiments, bid interval **1310** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval **1310** may be implemented as a table containing a bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as an entry in the table. In certain other further embodiments, bid interval **1310** may be implemented as a record structure instance containing pointers to record structure instances of bid commodity **1312**, bid time interval **1314**, bid price **1316**

and bid amount **1316-1**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1**. In certain further embodiments, bid interval **1310** may be implemented as an object instance containing pointer references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing handle references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1**.

Note that in certain embodiments, a bid interval collection **1300** may include, but is not limited to, bid intervals **1310** and **1320** containing different ephemeral, fungible commodities. In certain other embodiments, a bid interval collection may additionally include, but is not limited to, bid intervals for commodities which are not ephemeral, fungible commodities.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **19B** depicts a bid interval **1310** may contain no explicit reference to an ephemeral, fungible bid commodity, bid time interval **1314**, bid price **1316** and bid amount **1316-1** in accordance with certain embodiments.

Note that in certain embodiments, bid interval **1310** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval **1310** may be implemented as a table containing a bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as an entry in the table. In certain other further embodiments, bid interval **1310** may be implemented as a record structure instance containing pointers to record structure instances of bid commodity **1312**, bid time interval **1314**, bid price **1316**

and bid amount **1316-1**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1**. In certain further embodiments, bid interval **1310** may be implemented as an object instance containing pointer references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing handle references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1**.

Note that in certain embodiments, a bid interval collection **1300** may include, but is not limited to, bid intervals **1310** and **1320** containing different ephemeral, fungible commodities, not possessing explicit bid commodity designation **1312**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, a bid interval collection may additionally include, but is not limited to, bid intervals for commodities which are not ephemeral, fungible commodities, not possessing explicit bid commodity designation **1312**, but surmised by inclusion in distinct tables, linked lists and the like.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **19C** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** in accordance with certain embodiments.

Note that in certain embodiments, bid interval **1310** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval **1310** may be implemented as a table containing a bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount

1316-1 as an entry in the table. In certain other further embodiments, bid interval **1310** may be implemented as a record structure instance containing pointers to record structure instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing references to object class instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1**. In certain further embodiments, bid interval **1310** may be implemented as an object instance containing pointer references to object class instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing handle references to object class instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1**.

Note that in certain embodiments, a bid interval collection **1300** may include, but is not limited to, bid intervals **1310** and **1320** containing different ephemeral, fungible commodities. In certain other embodiments, a bid interval collection may additionally include, but is not limited to, bid intervals for commodities which are not ephemeral, fungible commodities.

In certain other embodiments, bid interval **1310** may contain no explicit reference to an ephemeral, fungible bid commodity, a bid time interval **1314** and bid price **1316** as discussed above.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **19D** depicts bid time interval collection **1318** containing bid time intervals **1314-1** and **1314-2** in accordance with certain embodiments.

Note that in certain embodiments, bid time interval collection **1318** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid time interval collection **1318** may be implemented as a table containing bid time intervals **1314-1** and **1314-2** as entries in the table. In certain other further embodiments, bid time interval collection **1318** may be implemented as a record structure instance containing pointers to record structure instances of bid time intervals **1314-1** and **1314-2**. In certain other further embodiments, bid time interval collection **1318** may be implemented as an object instance containing references to object class instances of bid time intervals **1314-1** and **1314-2**. In certain further embodiments, bid time interval collection **1318** may be implemented as an object instance containing pointer references to object class instances of bid time intervals **1314-1** and **1314-2**. In certain other further embodiments, bid time interval collection **1318** may be implemented as an object instance containing handle references to object class instances of bid time intervals **1314-1** and **1314-2**.

Note that in certain embodiments, a bid time interval collection **1318** may include, but is not limited to, one bid time interval **1314-1**. In certain embodiments, a bid time interval collection **1318** may include, but is not limited to, more than two bid time intervals.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **20A** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** in accordance with certain embodiments.

Note that in certain embodiments, bid interval **1310** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval **1310** may be implemented as a table containing a bid

commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** as an entry in the table. In certain other further embodiments, bid interval **1310** may be implemented as a record structure instance containing pointers to record structure instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain further embodiments, bid interval **1310** may be implemented as an object instance containing pointer references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing handle references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**.

Note that in certain embodiments, a bid interval collection **1300** may include, but is not limited to, bid intervals **1310** and **1320** containing different ephemeral, fungible commodities. In certain other embodiments, a bid interval collection may additionally include, but is not limited to, bid intervals for commodities which are not ephemeral, fungible commodities.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **20B** depicts a bid interval **1310** may contain no explicit reference to an ephemeral, fungible bid commodity, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** in accordance with certain embodiments.

Note that in certain embodiments, bid interval **1310** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval **1310** may be implemented as a table containing a bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** as an entry in the table. In certain other further embodiments, bid interval **1310** may be implemented as a record structure instance containing pointers to record structure instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain further embodiments, bid interval **1310** may be implemented as an object instance containing pointer references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing handle references to object class instances of bid commodity **1312**, bid time interval **1314**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**.

Note that in certain embodiments, a bid interval collection **1300** may include, but is not limited to, bid intervals **1310** and **1320** containing different ephemeral, fungible commodities, not possessing explicit bid commodity designation **1312**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, a bid interval collection may additionally include, but is not limited to, bid intervals for commodities which are not ephemeral, fungible commodities, not possessing explicit bid commodity designation **1312**, but surmised by inclusion in distinct tables, linked lists and the like.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **20C** depicts a bid interval **1310** containing an ephemeral, fungible bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** in accordance with certain embodiments.

Note that in certain embodiments, bid interval **1310** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, bid interval **1310** may be implemented as a table containing a bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2** as an entry in the table. In certain other further embodiments, bid interval **1310** may be implemented as a record structure instance containing pointers to record structure instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing references to object class instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain further embodiments, bid interval **1310** may be implemented as an object instance containing pointer references to object class instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**. In certain other further embodiments, bid interval **1310** may be implemented as an object instance containing handle references to object class instances of bid commodity **1312**, bid time interval collection **1318**, bid price **1316** and bid amount **1316-1** as well as committed flag **1316-2**.

Note that in certain embodiments, a bid interval collection **1300** may include, but is not limited to, bid intervals **1310** and **1320** containing different ephemeral, fungible commodities. In certain other embodiments, a bid interval collection may additionally include, but is not limited to, bid intervals for commodities which are not ephemeral, fungible commodities.

In certain other embodiments, bid interval **1310** may contain no explicit reference to an ephemeral, fungible bid commodity, a bid time interval **1314** or bid price **1316** as discussed above.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **21A** depicts a detail flowchart of operation **2032** of Figure **4B** performing creating the first knowledge interval of the knowledge interval collection based upon the first committed bid interval of the bid interval collection in accordance with certain embodiments.

Arrow **2470** directs the flow of execution from starting operation **2032** to operation **2472**. Operation **2472** performs creating the first knowledge interval of the knowledge interval collection based upon the first committed bid interval of the bid interval collection. Arrow **2474** directs execution from operation **2472** to operation **2476**. Operation **2476** terminates the operations of this flowchart.

Figure **21B** depicts a detail flowchart of operation **2472** of Figure **21A** further performing creating the first knowledge interval of the knowledge interval collection based upon the first committed bid interval of the bid interval collection in accordance with certain embodiments.

Arrow **2490** directs the flow of execution from starting operation **2472** to operation **2492**. Operation **2492** performs setting the amount of the first

knowledge interval by the first bid amount of the first committed bid interval. Arrow **2494** directs execution from operation **2492** to operation **2496**. Operation **2496** performs setting the first time interval of the first knowledge interval by the first bid time interval of the first committed bid interval. Arrow **2498** directs execution from operation **2496** to operation **2500**. Operation **2500** performs setting the first cost of the first knowledge interval by the first bid price of the first committed bid interval. Arrow **2502** directs execution from operation **2500** to operation **2504**. Operation **2504** terminates the operations of this flowchart.

Operations regarding setting an amount by a second amount may include, but are not limited to, straightforward assignment operations in certain embodiments. In certain embodiments, setting operations may further include, but are not limited to, incremental additions beyond just the amounts herein specified. In certain embodiments, setting operations may further include, but are not limited to, decremental subtractions beyond just the amounts herein specified. These incremental and decremental terms may be functions of the amount herein specified, such as local taxes, tariffs and other fees. They may vary over time.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **22A** depicts an equipment usage collection **1400** containing an equipment usage entry **1410** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage collection **1400** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage collection **1400** may be implemented as a table containing an equipment usage entry **1410** as an entry in the table. In certain other further embodiments, equipment usage collection **1400** may be implemented as a record structure instance containing a pointer to a record structure instance equipment usage entry **1410**. In certain other further

embodiments, equipment usage collection **1400** may be implemented as an object instance containing reference to an object class instance of equipment usage entry **1410**. In certain further embodiments, equipment usage collection **1400** may be implemented as an object instance containing a pointer reference to an object class instance of equipment usage entry **1410**. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing a handle reference to an object class instance of equipment usage entry **1410**.

Figure **22B** depicts an equipment usage collection **1400** containing no equipment usage entries in accordance with certain embodiments.

Note that in certain embodiments, equipment usage collection **1400** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage collection **1400** may be implemented as a table containing no equipment usage entry entries in the table. In certain other further embodiments, equipment usage collection **1400** may be implemented as a record structure instance containing no pointers to record structure instances of an equipment usage entry. In certain further embodiments, equipment usage collection **1400** may be implemented as a record structure instance containing a null pointer to a record structure instance of equipment usage entry. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing no references to an object class instance of equipment usage entry. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing a null reference to an object class instance of equipment usage entry. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing no pointer reference to an object class instance of equipment usage entry. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing a null pointer reference to an object class instance of equipment

usage entry. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing no handle references to an object class instance of equipment usage entry. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing a null handle reference to an object class instance of equipment usage entry.

Figure **22C** depicts an equipment usage collection **1400** containing equipment usage entries **1410**, **1420** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage collection **1400** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage collection **1400** may be implemented as a table containing equipment usage entries **1410** and **1420** as entries in the table. In certain other further embodiments, equipment usage collection **1400** may be implemented as a record structure instance containing pointers to record structure instances equipment usage entries **1410** and **1420**. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing references to an object class instance of equipment usage entries **1410** and **1420**. In certain further embodiments, equipment usage collection **1400** may be implemented as an object instance containing pointer references to an object class instance of equipment usage entries **1410** and **1420**. In certain other further embodiments, equipment usage collection **1400** may be implemented as an object instance containing a handle reference to an object class instance of equipment usage entries **1410** and **1420**. In certain other embodiments, equipment usage collection **1400** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of equipment usage entries **1410** and **1420**. In a similar fashion, object instances of **1400** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain equipment usage entries **1410** and **1420**.

In certain embodiments, more than two equipment usage entries may be contained in equipment usage collection **1400**. In certain embodiments, equipment usage collections may be implemented as collections of inferential clauses, wherein an equipment usage entry may in turn be represented as a collection of inferential clauses.

Figure **22D** depicts a second equipment usage collection **1402** containing equipment usage entries **1430** and **1440**, in accordance with certain embodiments.

Note that in certain embodiments, equipment usage collection **1402** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage collection **1402** may be implemented as a table containing equipment usage entries **1430** and **1440** as entries in the table. In certain other further embodiments, equipment usage collection **1402** may be implemented as a record structure instance containing pointers to record structure instances equipment usage entries **1430** and **1440**. In certain other further embodiments, equipment usage collection **1402** may be implemented as an object instance containing references to an object class instance of equipment usage entries **1430** and **1440**. In certain further embodiments, equipment usage collection **1402** may be implemented as an object instance containing pointer references to an object class instance of equipment usage entries **1430** and **1440**. In certain other further embodiments, equipment usage collection **1402** may be implemented as an object instance containing a handle reference to an object class instance of equipment usage entries **1430** and **1440**. In certain other embodiments, equipment usage collection **1402** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of equipment usage entries **1430** and **1440**. In a similar fashion, object instances of **1402** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain equipment usage entries **1430** and **1440**.

In certain embodiments, more than two equipment usage entries may be contained in equipment usage collection **1402**. In certain embodiments, only one equipment usage entry may be contained in equipment usage collection **1402**. In certain embodiments, no equipment usage entries may be contained in equipment usage collection **1402**. In certain embodiments, equipment usage collections may be implemented as collections of inferential clauses, wherein an equipment usage entry may in turn be represented as a collection of inferential clauses. In certain embodiments, more than two equipment usage collections may be implemented.

Figure **23A** depicts an equipment usage entry **1410** containing an ephemeral, fungible commodity **1412**, need schedule **1416** and delivery time **1414** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage entry **1410** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage entry **1410** may be implemented as a table containing a commodity **1412**, need schedule **1416** and delivery time **1414** as an entry in the table. In certain other further embodiments, equipment usage entry **1410** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1412**, need schedule **1416** and delivery time **1414**. In certain other further embodiments, equipment usage entry **1410** may be implemented as an object instance containing references to object class instances of commodity **1412**, need schedule **1416** and delivery time **1414**. In certain further embodiments, equipment usage entry **1410** may be implemented as an object instance containing pointer references to object class instances of commodity **1412**, need schedule **1416** and delivery time **1414**. In certain other further embodiments, equipment usage entry **1410** may be implemented as an object instance containing handle references to object class instances of commodity **1412**, need schedule **1416** and delivery time **1414**.

Note that in certain embodiments, an equipment usage entry collection **1200** may include, but is not limited to, equipment usage entries **1410** and **1220** containing different ephemeral, fungible commodities. In certain other embodiments, an equipment usage entry collection may additionally include, but is not limited to, equipment usage entries for commodities which are not ephemeral, fungible commodities.

Figure **23B** depicts an equipment usage entry **1410**, which may contain no explicit reference to an ephemeral, fungible commodity, need schedule **1416** and delivery time **1414** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage entry **1410** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage entry **1410** may be implemented as a table containing a commodity **1412**, need schedule **1416** and delivery time **1414** as an entry in the table. In certain other further embodiments, equipment usage entry **1410** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1412**, need schedule **1416** and delivery time **1414**. In certain other further embodiments, equipment usage entry **1410** may be implemented as an object instance containing references to object class instances of commodity **1412**, need schedule **1416** and delivery time **1414**. In certain further embodiments, equipment usage entry **1410** may be implemented as an object instance containing pointer references to object class instances of commodity **1412**, need schedule **1416** and delivery time **1414**. In certain other further embodiments, equipment usage entry **1410** may be implemented as an object instance containing handle references to object class instances of commodity **1412**, need schedule **1416** and delivery time **1414**.

Note that in certain embodiments, an equipment usage entry collection **1200** may include, but is not limited to, equipment usage entries **1410** and **1220** containing different ephemeral, fungible commodities, not possessing explicit commodity

designation **1412**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, an equipment usage entry collection may additionally include, but is not limited to, equipment usage entries for commodities which are not ephemeral, fungible commodities, not possessing explicit commodity designation **1412**, but surmised by inclusion in distinct tables, linked lists and the like.

Figure **23C** depicts an equipment usage entry **1410** containing an ephemeral, fungible commodity **1412**, need schedule collection **1418** and delivery time **1414** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage entry **1410** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage entry **1410** may be implemented as a table containing a commodity **1412**, need schedule collection **1418** and delivery time **1414** as an entry in the table. In certain other further embodiments, equipment usage entry **1410** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1412**, need schedule collection **1418** and delivery time **1414**. In certain other further embodiments, equipment usage entry **1410** may be implemented as an object instance containing references to object class instances of commodity **1412**, need schedule collection **1418** and delivery time **1414**. In certain further embodiments, equipment usage entry **1410** may be implemented as an object instance containing pointer references to object class instances of commodity **1412**, need schedule collection **1418** and delivery time **1414**. In certain other further embodiments, equipment usage entry **1410** may be implemented as an object instance containing handle references to object class instances of commodity **1412**, need schedule collection **1418** and delivery time **1414**.

Note that in certain embodiments, an equipment usage entry collection **1200** may include, but is not limited to, equipment usage entries **1410** and **1220** containing

different ephemeral, fungible commodities. In certain other embodiments, an equipment usage entry collection may additionally include, but is not limited to, equipment usage entries for commodities which are not ephemeral, fungible commodities.

In certain other embodiments, equipment usage entry **1410** may contain no explicit reference to an ephemeral, fungible commodity, a need schedule **1416** and delivery time **1414** as discussed above.

Figure **23D** depicts need schedule collection **1418** containing need schedules **1414-1** and **1414-2** in accordance with certain embodiments.

Note that in certain embodiments, need schedule collection **1418** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, need schedule collection **1418** may be implemented as a table containing need schedules **1414-1** and **1414-2** as entries in the table. In certain other further embodiments, need schedule collection **1418** may be implemented as a record structure instance containing pointers to record structure instances of need schedules **1414-1** and **1414-2**. In certain other further embodiments, need schedule collection **1418** may be implemented as an object instance containing references to object class instances of need schedules **1414-1** and **1414-2**. In certain further embodiments, need schedule collection **1418** may be implemented as an object instance containing pointer references to object class instances of need schedules **1414-1** and **1414-2**. In certain other further embodiments, need schedule collection **1418** may be implemented as an object instance containing handle references to object class instances of need schedules **1414-1** and **1414-2**.

Note that in certain embodiments, a need schedule collection **1418** may include, but is not limited to, one instance of a need schedule **1416-1**. In certain embodiments, a need schedule collection **1418** may include, but is not limited to, more than two need schedules.

Figure **24A** depicts a commodity need **1510** containing an ephemeral, fungible commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1** in accordance with certain embodiments.

Note that in certain embodiments, commodity need **1510** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need **1510** may be implemented as a table containing a commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1** as an entry in the table. In certain other further embodiments, commodity need **1510** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1**. In certain other further embodiments, commodity need **1510** may be implemented as an object instance containing references to object class instances of commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1**. In certain further embodiments, commodity need **1510** may be implemented as an object instance containing pointer references to object class instances of commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1**. In certain other further embodiments, commodity need **1510** may be implemented as an object instance containing handle references to object class instances of commodity **1512**, need time interval **1514**, cost limit **1516** and amount **1516-1**.

Note that in certain embodiments, a commodity need collection **1500** may include, but is not limited to, commodity needs **1510** and **1520** containing different ephemeral, fungible commodities. In certain other embodiments, a commodity need collection may additionally include, but is not limited to, commodity needs for commodities which are not ephemeral, fungible commodities.

Figure **24B** depicts a commodity need **1510** which may contain no explicit reference to an ephemeral, fungible commodity nor need time interval **1514** nor

cost limit **1516** but possessing amount **1516-1** in accordance with certain embodiments. Such an embodiment might only be checking for whether enough of the ephemeral, fungible commodity was available to perform the equipment tasks.

Note that in certain embodiments, commodity need **1510** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need **1510** may be implemented as a table containing a commodity **1512** and amount **1516-1** as an entry in the table. In certain other further embodiments, commodity need **1510** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1512** and amount **1516-1**. In certain other further embodiments, commodity need **1510** may be implemented as an object instance containing references to object class instances of commodity **1512** and amount **1516-1**. In certain further embodiments, commodity need **1510** may be implemented as an object instance containing pointer references to object class instances of commodity **1512** and amount **1516-1**. In certain other further embodiments, commodity need **1510** may be implemented as an object instance containing handle references to object class instances of commodity **1512** and amount **1516-1**.

Note that in certain embodiments, a commodity need collection **1500** may include, but is not limited to, commodity needs **1510** and **1520** containing different ephemeral, fungible commodities, not possessing explicit commodity designation **1512**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, a commodity need collection may additionally include, but is not limited to, commodity needs for commodities which are not ephemeral, fungible commodities, not possessing explicit commodity designation **1512**, but surmised by inclusion in distinct tables, linked lists and the like.

Figure **24C** depicts a commodity need **1510** containing an ephemeral, fungible commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1** in accordance with certain embodiments.

Note that in certain embodiments, commodity need **1510** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need **1510** may be implemented as a table containing a commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1** as an entry in the table. In certain other further embodiments, commodity need **1510** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1**. In certain other further embodiments, commodity need **1510** may be implemented as an object instance containing references to object class instances of commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1**. In certain further embodiments, commodity need **1510** may be implemented as an object instance containing pointer references to object class instances of commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1**. In certain other further embodiments, commodity need **1510** may be implemented as an object instance containing handle references to object class instances of commodity **1512**, need time interval collection **1518**, cost limit **1516** and amount **1516-1**.

Note that in certain embodiments, a commodity need collection **1500** may include, but is not limited to, commodity needs **1510** and **1520** containing different ephemeral, fungible commodities. In certain other embodiments, a commodity need collection may additionally include, but is not limited to, commodity needs for commodities which are not ephemeral, fungible commodities.

In certain other embodiments, commodity need **1510** may contain no explicit reference to an ephemeral, fungible commodity, a need time interval **1514** and cost limit **1516** as discussed above.

Figure **24D** depicts need time interval collection **1518** containing need time intervals **1514-1** and **1514-2** in accordance with certain embodiments.

Note that in certain embodiments, need time interval collection **1518** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, need time interval collection **1518** may be implemented as a table containing need time intervals **1514-1** and **1514-2** as entries in the table. In certain other further embodiments, need time interval collection **1518** may be implemented as a record structure instance containing pointers to record structure instances of need time intervals **1514-1** and **1514-2**. In certain other further embodiments, need time interval collection **1518** may be implemented as an object instance containing references to object class instances of need time intervals **1514-1** and **1514-2**. In certain further embodiments, need time interval collection **1518** may be implemented as an object instance containing pointer references to object class instances of need time intervals **1514-1** and **1514-2**. In certain other further embodiments, need time interval collection **1518** may be implemented as an object instance containing handle references to object class instances of need time intervals **1514-1** and **1514-2**.

Note that in certain embodiments, a need time interval collection **1518** may include, but is not limited to, one need time interval **1514-1**. In certain embodiments, a need time interval collection **1518** may include, but is not limited to, more than two need time intervals.

Figure **25A** depicts a commodity need collection **1500** containing a commodity need **1510** in accordance with certain embodiments.

Note that in certain embodiments, commodity need collection **1500** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need collection **1500** may be implemented as a table containing a commodity need **1510** as an entry in the table. In certain other further embodiments, commodity need collection **1500** may be implemented as a record structure instance containing a pointer to a record structure instance commodity need **1510**. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing reference to an object class instance of commodity need **1510**. In certain further embodiments, commodity need collection **1500** may be implemented as an object instance containing a pointer reference to an object class instance of commodity need **1510**. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing a handle reference to an object class instance of commodity need **1510**.

Figure **25B** depicts a commodity need collection **1500** containing no commodity needs in accordance with certain embodiments.

Note that in certain embodiments, commodity need collection **1500** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need collection **1500** may be implemented as a table containing no commodity need entries in the table. In certain other further embodiments, commodity need collection **1500** may be implemented as a record structure instance containing no pointers to record structure instances of a commodity need. In certain further embodiments, commodity need collection **1500** may be implemented as a record structure instance containing a null pointer to a record structure instance of commodity need. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing no references to an object class instance of commodity need. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing a null

reference to an object class instance of commodity need. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing no pointer reference to an object class instance of commodity need. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing a null pointer reference to an object class instance of commodity need. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing no handle references to an object class instance of commodity need. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing a null handle reference to an object class instance of commodity need.

Figure **25C** depicts a commodity need collection **1500** containing commodity needs **1510**, **1520** in accordance with certain embodiments.

Note that in certain embodiments, commodity need collection **1500** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need collection **1500** may be implemented as a table containing commodity needs **1510** and **1520** as entries in the table. In certain other further embodiments, commodity need collection **1500** may be implemented as a record structure instance containing pointers to record structure instances commodity needs **1510** and **1520**. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing references to an object class instance of commodity needs **1510** and **1520**. In certain further embodiments, commodity need collection **1500** may be implemented as an object instance containing pointer references to an object class instance of commodity needs **1510** and **1520**. In certain other further embodiments, commodity need collection **1500** may be implemented as an object instance containing a handle reference to an object class instance of commodity needs **1510** and **1520**. In certain other embodiments, commodity need collection **1500** may be implemented as a record

structure instance containing a pointer to a linked pointer list of record structure instances of commodity needs **1510** and **1520**. In a similar fashion, object instances of **1500** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain commodity needs **1510** and **1520**.

In certain embodiments, more than two commodity needs may be contained in commodity need collection **1500**. In certain embodiments, commodity need collections may be implemented as collections of inferential clauses, wherein a commodity need may in turn be represented as a collection of inferential clauses.

Figure **25D** depicts a second commodity need collection **1502** containing commodity needs **1530** and **1540**, in accordance with certain embodiments.

Note that in certain embodiments, commodity need collection **1502** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, commodity need collection **1502** may be implemented as a table containing commodity needs **1530** and **1540** as entries in the table. In certain other further embodiments, commodity need collection **1502** may be implemented as a record structure instance containing pointers to record structure instances commodity needs **1530** and **1540**. In certain other further embodiments, commodity need collection **1502** may be implemented as an object instance containing references to an object class instance of commodity needs **1530** and **1540**. In certain further embodiments, commodity need collection **1502** may be implemented as an object instance containing pointer references to an object class instance of commodity needs **1530** and **1540**. In certain other further embodiments, commodity need collection **1502** may be implemented as an object instance containing a handle reference to an object class instance of commodity needs **1530** and **1540**. In certain other embodiments, commodity need collection **1502** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure

instances of commodity needs **1530** and **1540**. In a similar fashion, object instances of **1502** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain commodity needs **1530** and **1540**.

In certain embodiments, more than two commodity needs may be contained in commodity need collection **1502**. In certain embodiments, only one commodity need may be contained in commodity need collection **1502**. In certain embodiments, no commodity needs may be contained in commodity need collection **1502**. In certain embodiments, commodity need collections may be implemented as collections of inferential clauses, wherein a commodity need may in turn be represented as a collection of inferential clauses. In certain embodiments, more than two commodity need collections may be implemented.

Figure **26A** depicts a detail flowchart of operation **2004** of Figure **4A** further performing determining the ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments.

Arrow **2510** directs the flow of execution from starting operation **2004** to operation **2512**. Operation **2512** performs examining an equipment usage collection comprised of equipment usage entries each containing a delivery time and a need schedule for the ephemeral, fungible commodity to create the ephemeral, fungible commodity needs over the planning time interval comprising an amount. Arrow **2514** directs execution from operation **2512** to operation **2516**. Operation **2516** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **26B** depicts a detail flowchart of operation **2452** of Figure **17B** performing making the first bid of the first bid amount at the first bid price for the first time

interval to create the first bid of the bid interval collection comprising the first bid amount as the bid amount; the first bid price as the bid price; the first time interval as the bid time interval in accordance with certain embodiments.

Arrow **2530** directs the flow of execution from starting operation **2452** to operation **2532**. Operation **2532** performs making the first bid of the first bid amount at the first bid price for the first time interval to create the first bid of the bid interval collection comprising the first bid amount as the bid amount; the first bid price as the bid price; the first time interval as the bid time interval based upon the ephemeral, fungible commodity needs over the planning time interval comprising the amount and the cost limit. Arrow **2534** directs execution from operation **2532** to operation **2536**. Operation **2536** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **27A** depicts a detail flowchart of operation **2512** of Figure **26A** further performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs over the planning time interval to create the device operating schedule in accordance with certain embodiments.

Arrow **2550** directs the flow of execution from starting operation **2512** to operation **2552**. Operation **2552** performs determining an equipment usage plan containing an equipment usage item comprised of an action belonging to an action collection comprising start-action, stop-action and throttle-action; as well as an activation time. Arrow **2554** directs execution from operation **2552** to operation **2556**. Operation **2556** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **27B** depicts a flowchart performing a method of controlling the device consuming the ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one of the knowledge intervals of the ephemeral, fungible commodity at the time interval containing the cost in accordance with certain embodiments.

Operation **2570** starts the operations of this flowchart. Arrow **2572** directs the flow of execution from operation **2570** to operation **2574**. Operation **2574** performs operating the device based upon the device operating schedule. Arrow **2576** directs execution from operation **2574** to operation **2578**. Operation **2578** terminates the operations of this flowchart.

Arrow **2580** directs the flow of execution from starting operation **2570** to operation **2000**. Operation **2000** performs operations discussed regarding Figure **4A**. Arrow **2582** directs execution from operation **2000** to operation **2578**. Operation **2578** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning the device operations and operating the device based upon those plans.

Figure **28A** depicts an equipment usage plan **1600** containing an equipment usage item **1610** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage plan **1600** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage plan **1600** may be implemented as a

table containing an equipment usage item **1610** as an entry in the table. In certain other further embodiments, equipment usage plan **1600** may be implemented as a record structure instance containing a pointer to a record structure instance equipment usage item **1610**. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing reference to an object class instance of an equipment usage item **1610**. In certain further embodiments, equipment usage plan **1600** may be implemented as an object instance containing a pointer reference to an object class instance of an equipment usage item **1610**. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing a handle reference to an object class instance of an equipment usage item **1610**.

Figure **28B** depicts an equipment usage plan **1600** containing no equipment usage items in accordance with certain embodiments.

Note that in certain embodiments, equipment usage plan **1600** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage plan **1600** may be implemented as a table containing no equipment usage item entries in the table. In certain other further embodiments, equipment usage plan **1600** may be implemented as a record structure instance containing no pointers to record structure instances of an equipment usage item. In certain further embodiments, equipment usage plan **1600** may be implemented as a record structure instance containing a null pointer to a record structure instance of an equipment usage item. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing no references to an object class instance of an equipment usage item. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing a null reference to an object class instance of an equipment usage item. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object

instance containing no pointer reference to an object class instance of an equipment usage item. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing a null pointer reference to an object class instance of an equipment usage item. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing no handle references to an object class instance of an equipment usage item. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing a null handle reference to an object class instance of an equipment usage item.

Figure **28C** depicts an equipment usage plan **1600** containing equipment usage items **1610**, **1620** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage plan **1600** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage plan **1600** may be implemented as a table containing equipment usage items **1610** and **1620** as entries in the table. In certain other further embodiments, equipment usage plan **1600** may be implemented as a record structure instance containing pointers to record structure instances equipment usage items **1610** and **1620**. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing references to an object class instance of an equipment usage items **1610** and **1620**. In certain further embodiments, equipment usage plan **1600** may be implemented as an object instance containing pointer references to an object class instance of an equipment usage items **1610** and **1620**. In certain other further embodiments, equipment usage plan **1600** may be implemented as an object instance containing a handle reference to an object class instance of an equipment usage items **1610** and **1620**. In certain other embodiments, equipment usage plan **1600** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of equipment usage items **1610** and **1620**. In a similar fashion, object

instances of **1600** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain equipment usage items **1610** and **1620**.

In certain embodiments, more than two equipment usage items may be contained in equipment usage plan **1600**. In certain embodiments, equipment usage plans may be implemented as collections of inferential clauses, wherein an equipment usage item may in turn be represented as a collection of inferential clauses.

Figure **28D** depicts a second equipment usage plan **1602** containing equipment usage items **1630** and **1640**, in accordance with certain embodiments.

Note that in certain embodiments, equipment usage plan **1602** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage plan **1602** may be implemented as a table containing equipment usage items **1630** and **1640** as entries in the table. In certain other further embodiments, equipment usage plan **1602** may be implemented as a record structure instance containing pointers to record structure instances equipment usage items **1630** and **1640**. In certain other further embodiments, equipment usage plan **1602** may be implemented as an object instance containing references to an object class instance of an equipment usage items **1630** and **1640**. In certain further embodiments, equipment usage plan **1602** may be implemented as an object instance containing pointer references to an object class instance of an equipment usage items **1630** and **1640**. In certain other further embodiments, equipment usage plan **1602** may be implemented as an object instance containing a handle reference to an object class instance of an equipment usage items **1630** and **1640**. In certain other embodiments, equipment usage plan **1602** may be implemented as a record structure instance containing a pointer to a linked pointer list of record structure instances of equipment usage items **1630** and **1640**. In a similar fashion, object

instances of **1602** may employ references, pointer references and handle references to instances of objects forming linked lists of references which contain equipment usage items **1630** and **1640**.

In certain embodiments, more than two equipment usage items may be contained in equipment usage plan **1602**. In certain embodiments, only one equipment usage item may be contained in equipment usage plan **1602**. In certain embodiments, no equipment usage items may be contained in equipment usage plan **1602**. In certain embodiments, equipment usage plans may be implemented as collections of inferential clauses, wherein an equipment usage item may in turn be represented as a collection of inferential clauses. In certain embodiments, more than two equipment usage plans may be implemented.

Figure **29A** depicts an equipment usage item **1610** containing equipment identifier **1612**, activation time **1614** and action **1616** in accordance with certain embodiments.

Note that in certain embodiments, equipment usage item **1610** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage item **1610** may be implemented as a table containing a commodity **1612**, activation time **1614** and action **1616** as an entry in the table. In certain other further embodiments, equipment usage item **1610** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1612**, activation time **1614** and action **1616**. In certain other further embodiments, equipment usage item **1610** may be implemented as an object instance containing references to object class instances of commodity **1612**, activation time **1614** and action **1616**. In certain further embodiments, equipment usage item **1610** may be implemented as an object instance containing pointer references to object class instances of commodity **1612**, activation time **1614** and action **1616**. In certain other further embodiments, equipment usage item **1610** may be implemented as an object

instance containing handle references to object class instances of commodity **1612**, activation time **1614** and action **1616**.

Note that in certain embodiments, an equipment usage plan **1600** may include, but is not limited to, knowledge intervals **1610** and **1620** containing different ephemeral, fungible commodities. In certain other embodiments, an equipment usage plan may additionally include, but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities.

Note that in certain embodiments, equipment usage item **1610** may be implemented in computer accessible memory coupled to a computer. In certain further embodiments, equipment usage item **1610** may be implemented as a table containing a commodity **1612**, activation time **1614** and action **1616** as an entry in the table. In certain other further embodiments, equipment usage item **1610** may be implemented as a record structure instance containing pointers to record structure instances of commodity **1612**, activation time **1614** and action **1616**. In certain other further embodiments, equipment usage item **1610** may be implemented as an object instance containing references to object class instances of commodity **1612**, activation time **1614** and action **1616**. In certain further embodiments, equipment usage item **1610** may be implemented as an object instance containing pointer references to object class instances of commodity **1612**, activation time **1614** and action **1616**. In certain other further embodiments, equipment usage item **1610** may be implemented as an object instance containing handle references to object class instances of commodity **1612**, activation time **1614** and action **1616**.

Note that in certain embodiments, an equipment usage plan **1600** may include, but is not limited to, knowledge intervals **1610** and **1620** containing different ephemeral, fungible commodities, not possessing explicit commodity designation **1612**, but surmised by inclusion in distinct tables, linked lists and the like. In certain other embodiments, an equipment usage plan may additionally include,

but is not limited to, knowledge intervals for commodities which are not ephemeral, fungible commodities, not possessing explicit commodity designation **1612**, but surmised by inclusion in distinct tables, linked lists and the like.

Figure **29C** depicts action **1616** of Figures **29A** and **29B** which can have a value belonging to an action collection comprising start-action **1616-1**, stop-action **1616-2** and throttle-action **1616-3**, in accordance with certain embodiments.

In certain embodiments, mapping **1670** action **1616** to start-action **1616-1** may be implemented as a bit mask and shift operation performed on a word or collection of words comprising the equipment usage item **1610**. In certain embodiments, mapping **1672** action **1616** to stop-action **1616-2** may be implemented as a bit mask and shift operation performed on a word or collection of words comprising the equipment usage item **1610**. In certain embodiments, mapping **1674** action **1616** to throttle-action **1616-3** may be implemented as a bit mask and shift operation performed on a word or collection of words comprising the equipment usage item **1610**.

In certain other embodiments, the mappings may be implemented table lookup functions applied to action **1616** to determine the member of the action collection represented. In certain other embodiments, the mappings may be implemented as references to class instances for a class action collection containing start-action, stop-action and throttle-action derived classes. In certain embodiments, the mappings may be implemented as pointers to executable code, possibly program steps.

Figure **30** depicts a detail flowchart of operation **2574** of Figure **27B** further performing operating the device based upon the device operating schedule in accordance with certain embodiments.

Arrow **2600** directs the flow of execution from starting operation **2574** to operation **2602**. Operation **2602** performs starting the device based upon the

device operating schedule. Arrow **2604** directs execution from operation **2602** to operation **2606**. Operation **2606** terminates the operations of this flowchart.

Arrow **2610** directs the flow of execution from starting operation **2574** to operation **2612**. Operation **2612** performs stopping the device based upon the device operating schedule. Arrow **2614** directs execution from operation **2612** to operation **2616**. Operation **2616** terminates the operations of this flowchart.

Arrow **2620** directs the flow of execution from starting operation **2574** to operation **2622**. Operation **2622** performs throttling the device based upon the device operating schedule. Arrow **2624** directs execution from operation **2622** to operation **2616**. Operation **2616** terminates the operations of this flowchart.

In certain embodiments, at least one of the operations **2602**, **2612** or **2622** may be implemented. In certain further embodiments, all of these operations may be implemented. In certain further embodiments, more than just these operations may be implemented.

In certain embodiments, there may be more than one device being controlled. In such embodiments, at least one of the operations **2602**, **2612** or **2622** may be implemented for each device. In certain further embodiments, all of these operations may be implemented for at least one device. In certain further embodiments, more than just these operations may be implemented for at least one device.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **31A** depicts a detail flowchart of operation **2602** of Figure **30** further performing starting the device based upon the device operating schedule in accordance with certain embodiments.

Arrow **2630** directs the flow of execution from starting operation **2602** to operation **2632**. Operation **2632** performs starting the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of a start-action. Arrow **2634** directs execution from operation **2632** to operation **2636**. Operation **2636** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **31B** depicts a detail flowchart of operation **2612** of Figure **30** further performing stopping the device based upon the device operating schedule in accordance with certain embodiments.

Arrow **2650** directs the flow of execution from starting operation **2612** to operation **2652**. Operation **2652** performs stopping the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of a stop-action. Arrow **2654** directs execution from operation **2652** to operation **2656**. Operation **2656** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **31C** depicts a detail flowchart of operation **2622** of Figure **30** further performing throttling the device based upon the device operating schedule in accordance with certain embodiments.

Arrow **2670** directs the flow of execution from starting operation **2622** to operation **2672**. Operation **2672** performs throttling the device based upon the

device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of a throttle-action. Arrow **2674** directs execution from operation **2672** to operation **2676**. Operation **2676** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **32A** depicts an equipment usage item comprised of an action **1616** and a throttle-setting **1616-10**.

In certain embodiments, an equipment usage item may be comprised of a throttle-action **1616-3** and a throttle-setting **1616-10**. In certain other embodiments, an equipment usage item may be comprised of a start-action **1616-1** and a throttle-setting **1616-10**. Note that in certain other embodiments, an equipment usage item may be comprised of a stop-action **1616-2** and a throttle-setting **1616-10**.

Throttle-settings as used herein refer to information which is used to control the device and thus its consumption, generation or transmission of the relevant ephemeral, fungible commodities.

Figure **32B** depicts a detail flowchart of operation **2622** of Figure **31C** further performing throttling the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of a throttle-action and the throttle-setting in accordance with certain embodiments.

Arrow **2690** directs the flow of execution from starting operation **2622** to operation **2692**. Operation **2692** performs throttling the device based upon the device operating schedule based upon at least one of the equipment usage items

of the equipment usage plan comprised of the throttle-action and the throttle-setting. Arrow **2694** directs execution from operation **2692** to operation **2696**. Operation **2696** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **32C** depicts a detail flowchart of operation **2632** of Figure **31A** performing starting the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of the start-action and the throttle-setting in accordance with certain embodiments.

Arrow **2710** directs the flow of execution from starting operation **2632** to operation **2712**. Operation **2712** performs starting the device based upon the device operating schedule based upon at least one of the equipment usage items of the equipment usage plan comprised of the start-action and the throttle-setting. Arrow **2714** directs execution from operation **2712** to operation **2716**. Operation **2716** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **33A** depicts a flowchart performing planning and controlling the device in accordance with certain embodiments, where the device includes a device collection comprised of at least two devices consuming the ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one of the knowledge intervals of the ephemeral, fungible commodity at the time interval containing the cost.

Operation **2730** starts the operations of this flowchart. Arrow **2732** directs the flow of execution from operation **2730** to operation **2734**. Operation **2734** performs operating the device collection based upon the device collection operating schedule. Arrow **2736** directs execution from operation **2734** to operation **2738**. Operation **2738** terminates the operations of this flowchart.

Arrow **2740** directs the flow of execution from starting operation **2730** to operation **2000**. Operation **2000** performs the method of planning the device consuming the ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at the time interval containing the cost to create the device collection operating schedule discussed regarding Figure **27B**. Arrow **2742** directs execution from operation **2000** to operation **2738**. Operation **2738** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **33B** depicts a detail flowchart of operation **2734** of Figure **33A** further performing operating the device collection based upon the device collection operating schedule comprising at least one of the collection in accordance with certain embodiments.

Arrow **2750** directs the flow of execution from starting operation **2734** to operation **2752**. Operation **2752** performs starting at least one of the devices of the device collection based upon the device operating schedule. Arrow **2754** directs execution from operation **2752** to operation **2756**. Operation **2756** terminates the operations of this flowchart.

Arrow **2760** directs the flow of execution from starting operation **2734** to operation **2762**. Operation **2762** performs stopping at least one of the devices of

the device collection based upon the device operating schedule. Arrow **2764** directs execution from operation **2762** to operation **2756**. Operation **2756** terminates the operations of this flowchart.

Arrow **2770** directs the flow of execution from starting operation **2734** to operation **2772**. Operation **2772** performs throttling at least one of the devices of the device collection based upon the device operating schedule. Arrow **2774** directs execution from operation **2772** to operation **2756**. Operation **2756** terminates the operations of this flowchart.

Note that in certain embodiments, at least one of the operations **2752**, **2762** and **2772** may be implemented for at least one device of the device collection. In certain further embodiments, all the operations **2752**, **2762** and **2772** may be implemented for at least one device of the device collection. In certain further embodiments, all the operations **2752**, **2762** and **2772** may be implemented for all devices of the device collection.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **34A** depicts a flowchart performing metering consumption by the device of the ephemeral, fungible commodity in accordance with certain embodiments.

Operation **2790** starts the operations of this flowchart. Arrow **2792** directs the flow of execution from operation **2790** to operation **2794**. Operation **2794** performs metering consumption by the device of the ephemeral, fungible commodity. Arrow **2796** directs execution from operation **2794** to operation **2798**. Operation **2798** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **34B** depicts a detail flowchart of operation **2794** of Figure **34A** further performing metering consumption by the device of the ephemeral, fungible commodity in accordance with certain embodiments.

Arrow **2810** directs the flow of execution from starting operation **2794** to operation **2812**. Operation **2812** performs measuring a consumption rate of the device of the ephemeral, fungible commodity within a metering time interval. Arrow **2814** directs execution from operation **2812** to operation **2816**. Operation **2816** performs determining the cost of the ephemeral, fungible commodity within the metering time interval based upon the knowledge time interval collection to create a metering cost factor of the ephemeral, fungible commodity during the metering time interval. Arrow **2818** directs execution from operation **2816** to operation **2820**. Operation **2820** performs calculating a consumption cost for the device based upon the consumption rate of the device of the ephemeral, fungible commodity with the metering time interval, and based upon the metering cost factor of the ephemeral, fungible commodity during the metering time interval and based upon the metering time interval to create a consumption cost for the device consuming the ephemeral, fungible commodity over the metering time interval. Arrow **2822** directs execution from operation **2820** to operation **2824**. Operation **2824** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **35** depicts a detail flowchart of operation **2794** of Figure **34A** further performing metering consumption by the device of the ephemeral, fungible commodity in accordance with certain embodiments.

Arrow **2830** directs the flow of execution from starting operation **2794** to operation **2832**. Operation **2832** performs maintaining an accumulated cost for the device of the ephemeral, fungible commodity. Arrow **2834** directs execution from operation **2832** to operation **2836**. Operation **2836** terminates the operations of this flowchart.

Arrow **2840** directs the flow of execution from starting operation **2794** to operation **2842**. Operation **2842** performs updating the accumulated cost for the device of the ephemeral, fungible commodity based upon the consumption cost for the device consuming the ephemeral, fungible commodity over the metering time interval. Arrow **2844** directs execution from operation **2842** to operation **2836**. Operation **2836** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **36A** depicts a detail flowchart of operation **2000** of Figure **4A** further performing a method of planning the device consuming two ephemeral, fungible commodities based upon the knowledge interval collections comprising at least one knowledge interval of ephemeral, fungible commodities at a time interval containing a cost in accordance with certain embodiments.

Arrow **2850** directs the flow of execution from starting operation **2000** to operation **2852**. Operation **2852** performs a method of planning the device consuming the ephemeral, fungible commodity and the second ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a cost and based upon a second knowledge interval collection comprising at least one knowledge interval of the second ephemeral, fungible commodity at a time interval containing a cost. Arrow **2854** directs execution

from operation **2852** to operation **2856**. Operation **2856** terminates the operations of this flowchart.

Note that in certain embodiments, a single knowledge interval collection may include knowledge intervals for more than one ephemeral, fungible commodity. In such embodiments the two knowledge interval collections will be considered to be both contained in this single knowledge interval collection.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **36B** depicts a detail flowchart of operation **2004** of Figure **4A** performing determining the second ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments.

Arrow **2870** directs the flow of execution from starting operation **2004** to operation **2872**. Operation **2872** performs determining the second ephemeral, fungible commodity needs over the planning time interval. Arrow **2874** directs execution from operation **2872** to operation **2876**. Operation **2876** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **36C** depicts a detail flowchart of operation **2008** of Figure **4A** performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule in accordance with certain embodiments.

Arrow **2890** directs the flow of execution from starting operation **2008** to operation **2892**. Operation **2892** performs examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule. Arrow **2894** directs execution from operation **2892** to operation **2896**. Operation **2896** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **37A** depicts a detail flowchart of operation **2000** of Figure **4A** further performing a method of planning the device consuming ephemeral, fungible commodity and generating a second ephemeral, fungible commodity based upon the knowledge interval collections comprising at least one knowledge interval of ephemeral, fungible commodities at a time interval containing a cost in accordance with certain embodiments.

Arrow **2910** directs the flow of execution from starting operation **2000** to operation **2912**. Operation **2912** performs a method of planning the device consuming the ephemeral, fungible commodity and the second ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a cost and based upon a second knowledge interval collection comprising at least one knowledge interval of the second ephemeral, fungible commodity at a time interval containing a price. Arrow **2914** directs execution from operation **2912** to operation **2916**. Operation **2916** terminates the operations of this flowchart.

Note that in certain embodiments, a single knowledge interval collection may include knowledge intervals for more than one ephemeral, fungible commodity.

In such embodiments the two knowledge interval collections will be considered to be both contained in this single knowledge interval collection.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **37B** depicts a detail flowchart of operation **2004** of Figure **4A** performing determining the second ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments.

Arrow **2930** directs the flow of execution from starting operation **2004** to operation **2932**. Operation **2932** performs determining the second ephemeral, fungible commodity needs over the planning time interval. Arrow **2934** directs execution from operation **2932** to operation **2936**. Operation **2936** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **37C** depicts a detail flowchart of operation **2008** of Figure **4A** performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule in accordance with certain embodiments.

Arrow **2950** directs the flow of execution from starting operation **2008** to operation **2952**. Operation **2952** performs examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a

device operating schedule. Arrow **2954** directs execution from operation **2952** to operation **2956**. Operation **2956** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **38A** depicts a detail flowchart of operation **2000** of Figure **4A** further performing a method of planning the device consuming ephemeral, fungible commodity and transporting a second ephemeral, fungible commodity based upon the knowledge interval collections comprising at least one knowledge interval of ephemeral, fungible commodities at a time interval containing a cost in accordance with certain embodiments.

Arrow **2970** directs the flow of execution from starting operation **2000** to operation **2972**. Operation **2972** performs a method of planning the device consuming the ephemeral, fungible commodity and the second ephemeral, fungible commodity based upon the knowledge interval collection comprising at least one knowledge interval of the ephemeral, fungible commodity at a time interval containing a cost and based upon a second knowledge interval collection comprising at least one knowledge interval of the second ephemeral, fungible commodity at a time interval containing a price. Arrow **2974** directs execution from operation **2972** to operation **2976**. Operation **2976** terminates the operations of this flowchart.

Note that in certain embodiments, a single knowledge interval collection may include knowledge intervals for more than one ephemeral, fungible commodity. In such embodiments the two knowledge interval collections will be considered to be both contained in this single knowledge interval collection.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **38B** depicts a detail flowchart of operation **2004** of Figure **4A** performing determining the second ephemeral, fungible commodity needs over the planning time interval in accordance with certain embodiments.

Arrow **2990** directs the flow of execution from starting operation **2004** to operation **2992**. Operation **2992** performs determining the second ephemeral, fungible commodity needs over the planning time interval. Arrow **2994** directs execution from operation **2992** to operation **2996**. Operation **2996** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **38C** depicts a detail flowchart of operation **2008** of Figure **4A** performing examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule in accordance with certain embodiments.

Arrow **3010** directs the flow of execution from starting operation **2008** to operation **3012**. Operation **3012** performs examining the knowledge interval collection based upon the ephemeral, fungible commodity needs and the second ephemeral, fungible commodity needs over the planning time interval to create a device operating schedule. Arrow **3014** directs execution from operation **3012** to operation **3016**. Operation **3016** terminates the operations of this flowchart.

In certain embodiments, these operations are supported by a program step residing in a coupled computer readable memory on at least one computer in a computing system supporting at least planning device operations.

Figure **39A** shows an application of certain embodiments in a passive mode: it will link to the system for the price information and cannot trade in the market.

Pricing information is received as indicated by arrow **3002**. The system **3000** plans device **3110** operation, based upon pricing information **3002**, in certain embodiments. In certain further embodiments, system **3000** plans and operates device **3110**, based upon pricing information **3002**.

In certain other embodiments, system **3000** plans device **3110** and device **3120** operation, based upon pricing information **3002**. In certain further embodiments, system **3000** plans and operates device **3110** and device **3120**, based upon pricing information **3002**.

In certain embodiments, system **3000** includes metering capabilities **3200**, based upon pricing information **3002**. In certain further embodiments, system **3000** includes metering **3200**, as well as planning and operating device **3110** and device **3120**, based upon pricing information **3002**.

System **3000** does not require a lot of intelligence. It requires just a simple chip or module that can be inserted in each device capable of receiving signals of a particular radio frequency and analyzing those figures in a very simple way. If the price goes up above certain amounts, it turns off. If the price goes down, then it turns on and so on.

The wireless application protocol, WAP, would automatically provide all the service required to formulate arrow **3002**. Alternatively, there can be a dedicated band allocation for, say, the U.S. where pricing information **3002** can be passively transmitted in a local area.

As a matter of principle communication **3002** can be wireline or any other means or mechanism to broadcast it. Wireline delivery of information can "ride" on power lines.

Local networks can provide pricing information **3002**, including home local networks. The pricing information **3002** can be distributed by a home web server. In certain embodiments, java becomes the language of web control for one's home based upon forward pricing of ephemeral, fungible commodities such as electricity.

Figure **39B** shows an application of certain embodiments in an active mode: it will link to the system for the price and trade interactions in the market.

Pricing information is received as indicated by arrow **3002**. Bidding information is transmitted as represented by arrow **3004**. The system **3000** plans device **3110** operation, based upon pricing information **3002**, in certain embodiments. In certain further embodiments, system **3000** plans and operates device **3110**, based upon pricing information **3002**. The system **3000** bids **3004** as part of the planning process.

In certain other embodiments, system **3000** plans device **3110** and device **3120** operation, based upon pricing information **3002**. In certain further embodiments, system **3000** plans and operates device **3110** and device **3120**, based upon pricing information **3002**. The system **3000** bids **3004** as part of the planning process.

In certain embodiments, system **3000** includes metering capabilities **3200**, based upon pricing information **3002**. In certain further embodiments, system **3000** includes metering **3200**, as well as planning and operating device **3110** and device **3120**, based upon pricing information **3002**. The system **3000** bids **3004** as part of the planning process.

The wireless application protocol, WAP, would automatically provide all the service required to formulate arrows **3002** and **3004**. Alternatively, there can be a dedicated band allocation in the U.S. for example, where pricing information **3002** and bidding information **3004** can be passively transmitted and received within a local area.

As a matter of principle, communication **3002** and **3004** can be wireline or any other means or mechanism to broadcast it. Wireline delivery of information can "ride" on power lines.

Local networks can provide pricing information **3002** and bidding **3004**, including home local networks. The pricing information **3002** and bidding **3004** can be distributed by a home web server. In certain embodiments, java becomes the language of web control for one's home based upon forward pricing of ephemeral, fungible commodities such as electricity.

Figure **40** depicts a simplified system block of a trading computing system **4000** supporting interaction between a collection of certified clients and a computing system based upon interactions involving a virtual trading floor in accordance with certain embodiments.

Trading computing system **4000** is comprised of at least one trading computing system **4020** coupled **4024** to computer readable memory **4026**. The communication and interaction between trading computing system **4000** and trading computing system **4020** is denoted by arrow **4022**. Such communication and interaction **4022** may employ a variety of communications technologies, including a wireless physical transport layer in certain embodiments. In certain alternative embodiments, communication and interaction **4022** may employ a wireline physical transport layer.

Note that in certain embodiments, these entities, the human being **4100**, corporate entity **4120**, agent **4140** and software agent **4160** communicate with

trading computing system **4000** by use of messages as represented by arrows **4102**, **4122**, **4142**, and **4182**, respectively. In certain embodiments, such messages may use a wireline physical transport layer as represented by one or more of the arrows **4102**, **4122**, **4142**, and **4182**. In certain embodiments, such messages may use a wireless physical transport layer as represented by one or more of the arrows **4102**, **4122**, **4142**, and **4182**. Such messages may use body signals in certain further embodiments. Such messages may further use hand signals. Such messages in other embodiments may use acoustic signaling of messages. Such messages in certain further embodiments may use verbal messages in a human language.

Software agent computer **4180** is coupled **4084** to computer readable memory **4086**. In certain embodiments, the program operating system supporting planning **2000** of ephemeral, fungible commodity consuming devices **3110** and **3120** resides in computer readable memory **4086**. In certain further embodiments, the program operating system further supports operating devices **3110** and **3120**. In certain embodiments, bidding is supported by the program operating system residing in computer readable memory **4086**. In such embodiments, the trading activity may be considered carried on by software agent **4160**.

The preceding embodiments have been provided by way of example and are not meant to constrain the scope of the following claims.